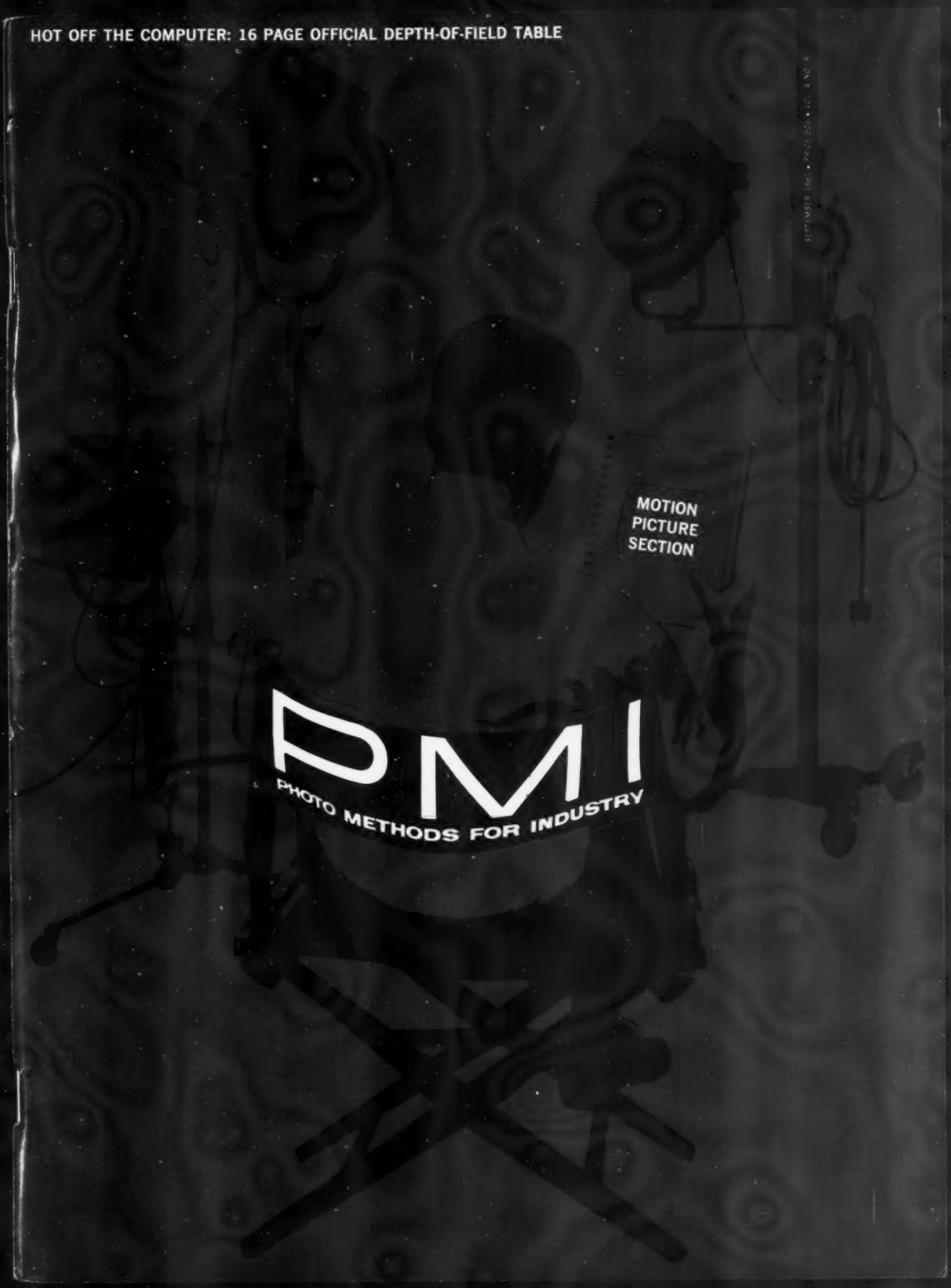
HOT OFF THE COMPUTER: 16 PAGE OFFICIAL DEPTH-OF-FIELD TABLE



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PICK UP AN M-3 OR AN M-2 AT YOUR LEICA DEALER. You'll do a double-take as you react to the famous Leica "feel." It's a legend among 3 generations of photographers... the magic of Leica design that makes it a "perfect fit" for combined action of hand, brain and eye. And... as you try it, you'll see why its rangefinder is accepted as the fastest and most precise, even in lowest light levels where others fail. Yet, in just 10 seconds (with Visoflex II) the same Leica camera becomes the most accurate eye-level reflex made. A **test focus** in every lens range will show you why Leica is the world's most versatile 35mm camera for every kind of picture... from extreme close-up through telephoto.

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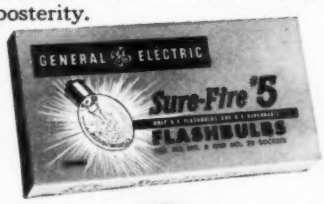
HOW WOULD YOU HAVE LIGHTED THIS PICTURE?

PRESS PHOTOGRAPHER BOB FREE TELLS HOW HE WOUND UP A STAIRCASE ASSIGNMENT WITH G-E #5 FLASHBULBS

"This is a 'before' picture—before the wrecking crews went to work," writes Robert Free of The Cincinnati Enquirer. "They were getting ready to tear down the old Studio Building—a noted landmark in the Queen City. The assignment from my paper couldn't have been clearer—preserve the staircase for posterity.

"When I arrived at the scene, the building was black as pitch—the electricity had been cut off. The only light in the building came from the skylight atop the stairs. I was left with little doubt as to what I could use for lighting. G-E Flashbulbs were the only answer.



"I placed my Rolliecord, loaded with 120 Verichrome Pan film, on a tripod and stopped the lens down to f/22. I then began climbing the stairs, painting my subject with light as I covered the 4 floors. I used 12 G-E #5 Flashbulbs, 3 on each floor level. I find nothing can hold a candle to G-E Flashbulbs when you need dependable lighting."

GENERAL ELECTRIC PAYS $50.00 upon acceptance of photographs illustrating difficult lighting problems you've solved with General Electric Flashbulbs. Send your picture with a detailed description to: Photo Lamp Department, General Electric Company, Nela Park, Cleveland 12, Ohio.

GENERAL ELECTRIC

Get more information. Circle 434, page 91

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AUDITED PAID CIRCULATION ABC

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PPA Convention report to professional photographers from The FR Corporation

1026 see FR Color Prints made in PPA Convention hotel room

The "darkroom" was a crowded hotel room.

The processing "sink" was a folding aluminum table with three trays and a wash tank. Temperature control was nonexistent.

Yet despite these "impossible" working conditions—every hour on the hour another color print was made before an audience of 50 to 65 professional photographers.

Moreover, they skeptically watched every step—beginning with exposure—under a bright safelight. And after only 7 minutes room lights were turned on.

Reactions from the audience ranged from, "I don't believe it"—to "This is the answer we've been looking for."

In view of this, we hope you will indulge us, when we proudly say, that this could only have been accomplished with the new FR 3 tray color process. (Developer, 5 minutes—Fixer, 3 minutes—Bleach, 10 minutes.)

If you are not already acquainted with this wonderful new process, we hope you'll find the following facts interesting:

Judge exposure after only seven minutes

Once you've turned on the room lights (after the print has been fixed one minute of its total three minutes) you can accurately judge whether the density is correct.

The print at this point is somewhat sepia colored since it still contains unbleached silver. However, after you've gained experience with the process you can take an educated guess about your color balance even at this point.

When the print is in the final wash (within 24 minutes of your starting time) you see the colors exactly as they appear when the print is dry. No need for guessing—you can tell definitely whether or not your filtration is correct.

No refrigeration—less critical temperature control

Temperature control of solutions is no great problem. It is far less critical than with other color systems. In fact, you can work within quality black and white tolerances and get brilliant results.

Perhaps even more important—*FR Color Paper can be stored without refrigeration—without changing characteristics.*

Use regular black and white equipment

Any professional black & white darkroom is set up to handle color with FR materials. You don't have to invest in specialized color equipment to do color work. Your standard sinks, trays, timers, thermometers and enlargers are all you need for the new FR Color System.

And of course if you're already set up for color processing your equipment is perfectly usable with FR Color. In fact, it will operate more efficiently than ever before because FR's three bath system takes less time and takes up less space.

What FR Color means to professional photographers

Now every darkroom can handle color—without a major investment in equipment or space. Now every studio, every commercial photographer, every wedding photographer, can use the magic of color to increase sales.

In industry, the photographic department's function will gain even greater importance as the sales merchandising, manufacturing, publicity departments, etc. start clamoring for color. And as the demand grows the photographic department will also grow in size and stature.

For further information, speak to your photographic dealer, or write The FR Corporation, Professional Color Department H, 951 Brook Avenue, New York 51, N.Y.

Get more information. Circle 431, page 91

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Get more information. Circle 464, page 91

David B. Eisendrath, Jr.

WORKING PHOTOGRAPHER

Some comments on photo department procedures and headaches

Each year at the National Industrial Photographic Conference (like the one held in New York the first week of last month) there are a number of round-tables held each day on a number of the topics which have been subjects for formal presentation. The sessions are well attended and sometimes they have gone on for many hours. When you get a bunch of industrial photographers together who are all eager to learn new techniques or better the ones they are now using, and when they stimulate each other with questions and answers, it often becomes a major place for exchange of ideas.

This year, as in the past, there was an "open-end" round table held on the Sunday before the formal industrial programs began; the informal symposium being arranged to warm-up early arrivals, get the gang together, and to cover some of the many subjects that are not covered in the other more specialized round tables. Some of the subjects covered this year were most interesting and I feel many of the comments well worth reporting to you.

Although well attended, most of these suggestions and comments were made by those who had attended the conference before, and all are quite experienced administrators in the field.

Personal work

Someone asked just what the feeling was in large industrial departments on the subject of a photo department employee being allowed to do personal or "government" work on the job. The consensus was that an occasional personal print by a departmental employee for himself was generally tolerated. Several people pointed out that inasmuch as it would probably be done anyway, it was much better to have it done openly—then you knew how much was being done and could control or discourage the practice when and if it interfered with production. Several supervisors commented that they encouraged their photographers to do any experimental or personal photography they wanted, as long as it didn't interfere with assigned work. The department often gained from the research, the shots made unassigned that were useful, etc.

Turning business away

Someone asked what you did about the non-departmental employee who wanted personal work done. Orlin Donaldson of Bethlehem Steel said they charged for the materials and added a service charge, explaining that they were not in the photo-finishing business; this discouraged requests for personal work. Ewell Jennings of Chance Vought reported that they always charged work to departments and couldn't accept work without authorization, another technique to discourage.

Cliff Pareis of Prudential Insurance said that they have no accounting system that allows them to handle personal work so there is no way to accept cash payment. As an employee-relations gesture they will occasionally do courtesy prints but only after regular work is done. When people find they have to wait for delivery, too much of this is discouraged. Orlin Donaldson then added that they permit their own photographers to do a small amount of personal work but never for sale or commercial use. It's always done on the employees own time, or when company work is done. Orlin commented that forbidding photo department employees to make prints is like a restaurant forbidding employees to eat. In the long run, encouraging the darkroom people to make pictures and learn more about photography helps to develop better photographers. He also said that you had no

(continued on page 85)

Sharper than a razor's edge...

Uncropped, unretouched photograph by Morris Karol using a Minolta SR-1 with 100 mm Rokkor f:3.5 lens on extension bellows. Exposure with floodlights was 1/8 sec at f:11.

Captured by the rare earth Rokkor lens made for the

MINOLTA SR-1

35 mm Single Lens Reflex

Sharp is the word for the Rokkor lens. Sharper than the brand new razor in this photograph. Sharp enough to show the subtle textures and machine marks in its polished steel. More than sharp enough to capture every bit of detail any subject possesses.

Only on Minolta will you find these high definition, high precision optics. Proof again that Minolta, not price, is your best guide to quality.

Instant return mirror • Automatic diaphragm • Double-bright viewing, condensing and Fresnel System • Non-spinning shutter speed dial, 1 to 1/500 & B • Lock-in half stops • Automatic reset counter with magnifier window • Double coated f:2 lens needs no UV filter • Rapid rewind • Separate FP & X sync terminals • fast on-off bayonet lens mount • Self-timer with built-in bypass • Matching LVS numbers.

12 interchangeable lenses • 28 precision accessories

"If your dealer does not carry Minolta Cameras, send $169.50 plus $10 handling and shipping costs for the Minolta SR-1, with double coated, 6-element, 55 mm, f:2, automatic, Rokkor lens. Case $15.00."

MINOLTA CORPORATION

200 Park Avenue South
New York 3, New York

Get more information. Circle 461, page 91

HE CHOSE BOLEX A MILLION MILES AGO

(and enjoyed handling ease, versatility and precision every step of the way)

When photographer George Perkins II accepted a south-of-the-border travelogue filming assignment 11 years ago, he marked down two camera requirements: High quality, light weight. He then selected the 16mm Bolex.

The result of that trip was a feature length color film of Mexico, the Yucatán Peninsula and Guatemala of such quality that it is still in demand in lecture halls.

Now at the million-mile mark in his camera travels, Perkins, an associate of the Burton Holmes Travelogues Company of Hollywood, has looked through the lens of his Bolex at memorable scenes in 22 countries around the world. "The feeling of real pleasure I had when I first took my 16mm Bolex from its case that day in Mexico has only been multiplied in the years since," Perkins says.

"The way it handles, the ease with which it can be hand-held, the versatility of its three-lens turret . . . Superb through-the-lens viewing and focusing and the new variable shutter and viewer that match so perfectly with so many lenses . . . All these qualities make Bolex an exceptional camera for my work in travel photography and in the industrial-commercial field." That's how a professional enthuses about *his* Bolex.

The pleasure Bolex has brought Mr. Perkins has been shared by travel film audiences in more than 200 cities in the United States and Canada. You can get in on the Bolex fun for a surprisingly low investment.

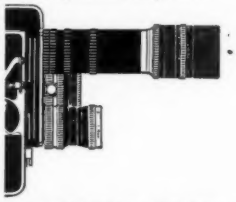
•

. . . Another example of Bolex getting the job done for the professional.

Bolex Cameras and Accessories
For Every Professional Effect

Pan Cinor 85: *Zooms from 17mm for wide-angle effects to 85mm telephoto with split-image finder. Lens opens to f/2.0. C and EK mount for 16mm cameras. $420.00.*

Precision-Ground Lenses: *Switar 10mm f/1.6 wide-angle, $149.50; Switar 25mm f/1.4 normal lens, $168.00; Switar 75mm f/1.9 fast telephotos, $145.00.*



Bolex 16mm Extension Tubes: *For macrocinematography. Sharper close-ups of very small objects. Set of four, $15.00.*

Bolex Projector: *Special 16mm optical/magnetic sound projector, full range of audio-visual controls for all professional screening possibilities. Choice of three lenses. With Standard f/1.3 50mm lens, $1250.*

The Bolex H-16 Rex with reflex viewing, variable shutter, 3 lens turret and Lytar f/1.8 lens costs only $450.00. Workmanship for all Bolex equipment is to the most precise tolerances on the 16mm market. Bolex lenses are matched for uniform sharpness, exposure and color rendition. Bolex cameras and accessories offer the professional utility many studios have paid thousands of dollars for. Write for literature and the name of your nearest Bolex dealer.

All prices include F.E.T. where applicable.

PAILLARD Incorporated, 100 Sixth Avenue, New York 13, N.Y.

BOLEX

Get more information. Circle 472, page 91

F.Y.I.

Included in PMI's report on PPofA is mention of a new 70mm hand camera introduced by Beattie-Coleman. The introduction, however, is slightly tentative, if such a combination is possible (slightly pregnant, for example, is not). Possible or not, the cameras shown were hand-made models. These cameras are not yet in production nor will they go into production until you, learned reader, have given Beattie-Coleman the word.

In short, they want to hear what you think of the camera. What features do you want? What lens would you prefer? Are there any accessories which you feel should be available? How much do you think this camera should sell for? Think about this and send your ideas to J. B. Olsson, Beattie-Coleman, Inc., 1000 North Olive Street, Anaheim, Calif.

Spinach or broccoli

Looking through our venerable contemporary, *The British Journal*, we found a new item to add to our growing list of "what is photography?" It seems that in West Germany, craftsmen such as carpenters, watchmakers, plumbers, etc., are subject to a trade tax. Professional people (we all know who they are) are exempt.

Photographers are non-exempt, a status that was challenged by a West German advertising photographer. He claimed he was an 'artist.' The judges said "nein" or something to that effect and he had to pay up.

While the ruling may have been a blow at both purse and ego, there is something to be said for the photographer as a craftsman. In fact, after some years of looking at assorted photographs, the one element conspicuous by its absence in most of them was craftsmanship, good, clean technique without which any pretense at art is impossible.

Making the British scene

One of our favorite pastimes as a sometime economist is reading classified ads. It is amazing how much you can tell about a city by the type of houses for sale, prices of used cars, job opportunities, etc. Recently we read some of the ads in *The British Journal*. There were a number of vacancies for photographers and assorted photographic types which we thought might be of interest to our readers.

The Royal Air Force is looking for photographers, minimum age 21, with a starting salary of $1456 a year; maximum $2156. A Trainee Film Editor for the BBC television can start at $2128 a year and go up to $2534 upon promotion to Assistant Film Editor. It would seem, reading various advertisements, that the range of salaries for photographers is $1800 to $2100.

Just for fun, we looked at ads for cameras and equipment to see if they were equally low in price. They weren't. A Hasselblad 500C sells for $755 compared to $550 here. A Graphic View is $375 without a lens while a Mamiyaflex with the 80mm f/2.8 lens is about $279.

There may be a moral somewhere but far be it from us to editorialize.

Mostly personal

Looking through our mail, we find that **John B. Pigaty** is now a vice-president at Kiernan Optics, Monrovia, Calif. **Morris B. Day** will be Superintendent of Manufacturing of the firm which makes optical assemblies and components.

Zeiss Ikon was awarded a Gold Cup by the "Comite du Bon Gout Francais" (Committee of Good Taste French) for general design and quality.

Gordon West of Saskatchewan received the PPA scholarship for a year's study at Rochester Institute of Technology.

D. R. Condon, Manager of the Photographic Laboratory, United States Testing Company, was appointed to a Photographic Advisory Group established by the American Society for Testing Materials. The group will solve photographic problems and advise on

(continued on page 84)

COMING UP

SEPTEMBER 11-15 Sixteenth Annual ISA Instrument-Automation Conference and exhibit. Biltmore Hotel, Memorial Sports Arena, Los Angeles, Calif.

SEPTEMBER 11-15 Marine Sciences Instrumentation Symposium. Woods Hole Oceanographic Institution. Woods Hole, Massachusetts.

SEPTEMBER 20-21 Industrial Electronics Symposium. Bradford Hotel, Boston.

SEPTEMBER 26-29 The American Society of Magazine Photographers, Photo Journalism Conference in the West. Asilomar, Calif.

OCTOBER 2-6 SMPTE 90th Convention, Lake Placid Club, Essex County, N. Y.

OCTOBER 4-6 North Atlantic Region, American Soc. of Photogrammetry, Semi-annual Convention and Technical Exhibit, Biltmore Hotel, New York City.

OCTOBER 9-11 Industrial Film & A-V Exhibition. Barbizon-Plaza Hotel, New York City.

NOVEMBER 8-10 Conference on 8mm Sound Film and Education, sponsored by the project in Educational Communication of the Horace Mann-Lincoln Institute of School Experimentation, Teachers College, Columbia University, New York City.

NOVEMBER 16-25 Second International Festival of Technical and Scientific Films and Session of the Popular Science Section of ISFA, Budapest, Hungary. Four Seasons Travel, 5705 Chene St., Detroit.

NOVEMBER 17-20 Sixth Annual International Midwest Photo Show, Detroit Light Guard Armory, Detroit, Mich.

MONTHLY MEETINGS

Binghamton Chapter Society of Photographic Scientists and Engineers Meetings every third Tuesday. Contact H. G. Morse, Ansco, Binghamton, N. Y. RA 2-4221, Ext. 573.

Association of Federal Photographers Meetings every third Wednesday at 8 p.m. G.S.A. Building, 7th and D Sts., S.W., Washington, D. C.

Boston Chapter SPSE Contact John Taylor, Itek Corp., 10 Maguire Rd., Lexington, Mass., VO 2-6200.

Chicago Chapter Biological Photographic Assoc. Meetings every third Tuesday. Contact Dorothy Pinkham, 551 W. Grant Pl., Chicago. DI 8-6400.

Chicago Chapter Society of Reproduction Engineers Meetings every third Monday. Contact Kendrick R. Baxter, The Seeburg Corp., 1500 N. Dayton St., Chicago 22, Ill. MI 2-0800.

Cleveland Chapter SPSE Meetings the first Tuesday of each month. Cleveland Engineering & Scientific Center, 3100 Chester Ave., Cleveland, Ohio. Contact Robert E. Birr, General Electric, Nela Park, Cleveland. GL 1-6600.

Industrial Photographers of America Essex House, Newark, N. J. Meetings every second and fourth Thursday. Contact Tom Holberton, 181 Lake Drive West, Packanack Lake, Wayne, N. J. or R. Handley, The Port of New York Authority, 111 8th Ave., N.Y.C.

(continued on page 17)

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for ready-to-project movie film in 60 seconds!

RAPROMATIC – the revolutionary pre-saturated Raproroll® web technique – now offers you two self-contained completely portable laboratories for fastest on-the-spot processing to a negative. No pumps, no applicators, no free flowing fluids – no additional equipment needed. Superior image quality, maximum contrast, fog levels as low as 0.01, resolution retention at all cine rates. Unlimited applications for instrumentation recording, sporting events, oscillo recording, TV news, cinefluorography, industrial, microfilm, medical and other fields demanding immediate access to results.

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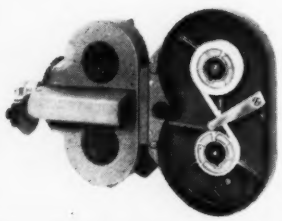
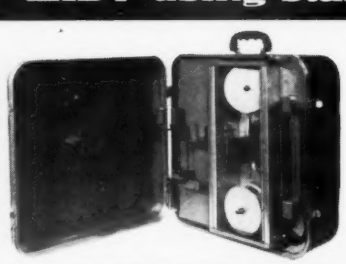
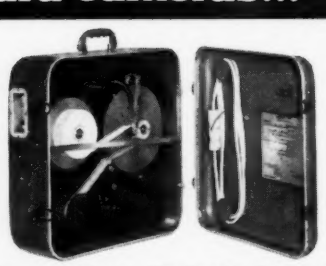
LAB 1 - using standard cameras...



Rapromatic Magazine with Standard Camera
Magazine processor adapts any 16, 35 or 70mm cine camera to develop and fix film as you shoot. Spring loaded roller is only modification needed on standard magazines.



Rapromatic Model 410 Portable Washer-Dryer
Companion unit for magazine processor or portable processor. Weighs only 30 pounds, operate from normal house current. Static wash-dry speeds adjustable up to 25 ft./min.



Rapromatic Model 470 Portable Processor
Develops and fixes 16, 35 or 70mm film at speeds up to 50 feet per minute. Weighs only 30 pounds, accommodates reels up to 400 feet. Motor drive, hand crank for field use.

LAB 2 - using Rapromatic magazine

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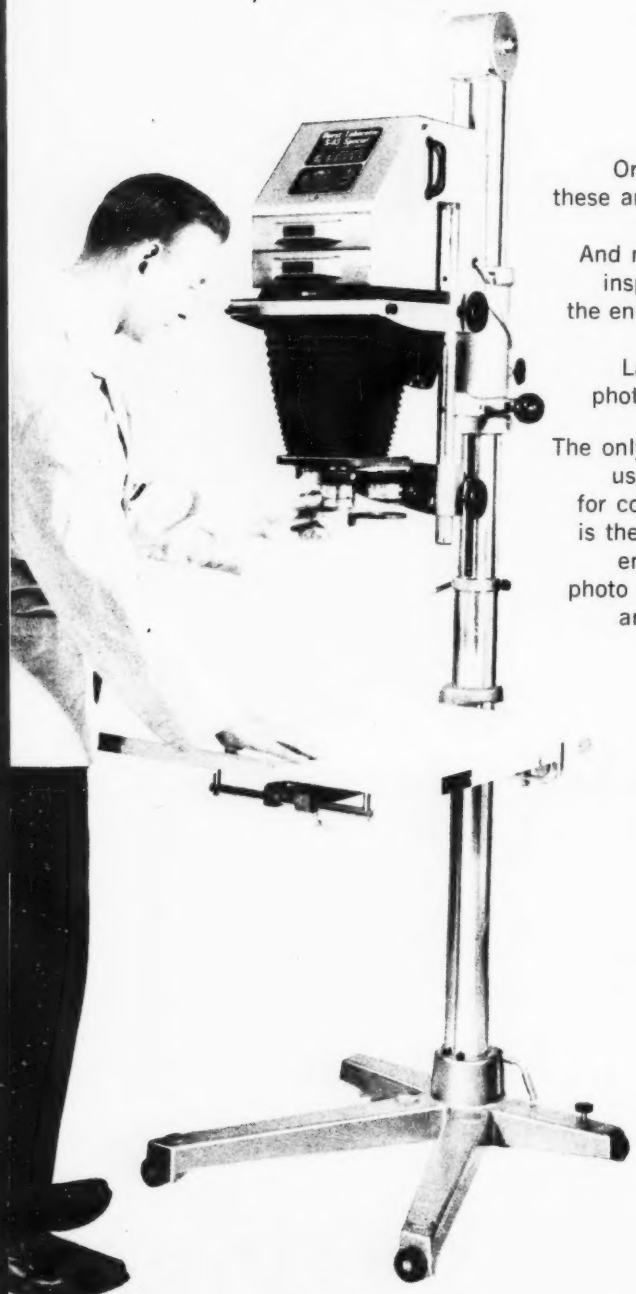
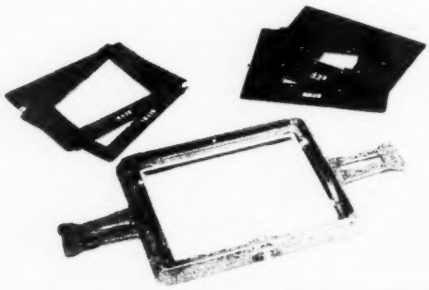
For 4 x 5 Negatives and Smaller



Original Design, Precision Automation, Functional Detail, these are the qualities which make Durst Enlargers first and foremost in the world of contemporary photography. And now – from the revolutionary design concepts daringly inspired by Durst – comes the Laboratator S-45 Special... the enlarger created specially for the advanced photographic laboratory. Like all Durst Enlargers, the three-lens Laboratator S-45 Special is among the few truly original photographic instruments to have appeared in a decade.

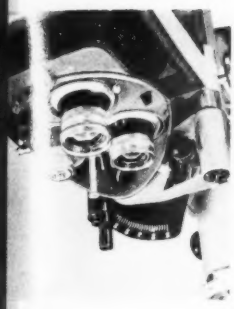
The only 4 x 5 enlarger with built-in features that enable its user to do a high-speed, precision job without the need for costly, time consuming accessories. The S-45 SPECIAL is the most versatile, the most precise, the most advanced enlarging apparatus ever designed – for the specialized photo laboratory in Industry, Scientific Institutions, Printing and Processing Trades, Civil and Military Departments, Professional and Commercial Studios!



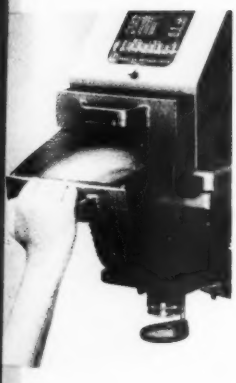
• **Exclusive Durst "NEGA" Focusing Negative Carrier plus Built-In Masks—standard equipment in the S-45!** A precision-tooled metal frame, it holds optical glass flats or glassless film holders. Adaptable for the registration required in color separations, the carrier also offers adjustments for distortion-control, with a scale indicating the exact degree of tilt. Spring-controlled . . . the carrier slips out . . . locks in – with ease! **Built-in** to the enlarger head, below the negative holder, is a set of masks which automatically close in to center any portion of the negative in the optical axis.

-45 Special ENLARGER

Everything about the Durst S-45 Laborat

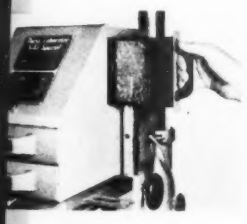


●**Tri-Lens Turret with Click-Stop Positions, Red Filter Holder and Special Distortion Control!** Mounted on lensboards and inserted into quick-change sockets, any 3 lenses are automatically positioned in the proper optical axis with a simple "click-stop" fingertip adjustment. Distortion correction is affected with an easy turn of a knob – tilting the lens platform 10° in one direction or 20° in the other. An eloxadized scale quickly shows the degree of tilt and a quick-set screw holds the position. A click position for zero level automatically sets lens standard back to normal. In the center of the turret is a special adjustable axle and filter holder—bearing a red safety filter which swings freely to adapt to each lens. Latirad Accessory Filter Turntable can replace the holder for special filters used in color enlargements and separations.

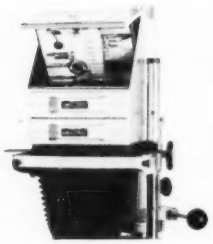


●**Color-Corrected Interchangeable Condensers!** A Durst exclusive – condensers singly mounted in rectangular "drawers" just above the negative stage assure short exposure times and maximum brilliance—with full, even illumination from edge to edge. Simple to change . . . easy to clean—they slip in—slip out . . . just like a modern film cassette! A reference table showing recommended combinations of negative size, lens, and condenser appears directly on the lamp house.

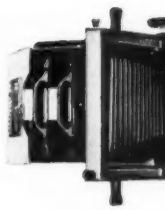
For Soft-Focus Diffused Lighting in Color or Black and White . . . the Durst "Lacoli" cold light grid accessory replaces the lower condenser drawer. Ideal for hard negatives – its powerful light enables short exposure times to be achieved . . . even with papers of low sensitivity. Suppresses scratches and blemishes, makes retouching rarely necessary.

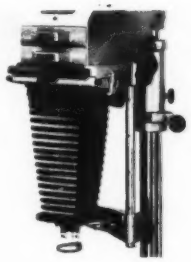


●**Special Built-in Color Filter** Drawer between light source and condensers. Accepts 4¾" x 4¾" filters. Scratches, fingerprints and dust have no effect on the final result. For added safety—there's a special heat-absorbing filter between the filter drawer and lamphouse to protect filters and negative. When the enlarger head is turned for horizontal projection, the filter drawer can be easily reversed for maximum convenience. The filter holder accepts filters for color separations, color printing, and black-and-white variable contrast enlarging papers. (See accessories).

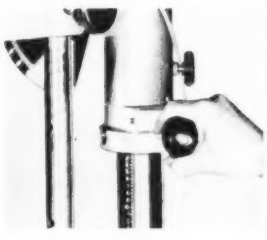


●**Simple Conversion Into Precision 3 Lens Distortion-Controlled Copy Camera Reflex Viewing/Focusing!** For photographing materials on the baseboard, from the wall or copyboard, the special Larep accessory cassette substitutes for the negative holder . . . the enlarger head is unlocked and the projection mirror is reversed for viewing (down through the condenser system to the ground glass on the copy cassette), composition and focusing. The conversion to camera is complete! The reversible deflecting mirror sits just forward of the filter system. Inclined at a 45° angle, it reverses the light 90° into the optical system . . . provides clear viewing just like a mirror-reflex system.





●**Double Bellows Extension Permits Extreme Reductions As Well As Enlargements Right on the Baseboard** . . . with all negatives from 35mm to 4 x 5. Enlarging and reducing to a factor of about 0.28 to 1 and as high as 31 diameter is possible **on the baseboard.** And this double extension bellows is adjusted for each focal length on a tubular focusing guide. Bellows also make possible fine micrometer adjustments in size for ultra precise work.



●**Rapid Lamphouse Raising And Lowering . . . Micrometer Adjustments Possible!** Special ball handle friction drive means effortless raising and lowering for fast picture size changes or micro-settings. SPECIAL NOTE: The enlarger head is counterbalanced by an aircraft-type steel cable which is synchronized to a sealed stainless pulley, counterweight and coilspring—all concealed inside the enlarger column. Absolutely no servicing is required and the special elevation collar is suspended with self-lubricated bronze bearings. This ingenious construction means the smoothest rides up, the smoothest rides down and instant lateral positioning.

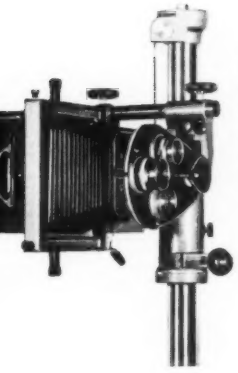
● **Durst Lifetime Trouble-Free Construction!** From the enlarger head to the base only the finest of materials are used in the precision construction of the Durst S-45. The self-lubricating enlarger column is seamless tubular steel [illegible] and nickel-chromium plated. The enlarger head and collar are stamped [illegible] of the best metal and coated so as to be impervious to chemical action. The uniquely engineered vibration-free base features a low, wide foot design and eliminates all oscillation between baseboard and enlarger head.

and...AT THIS NEW LOW PRICE!

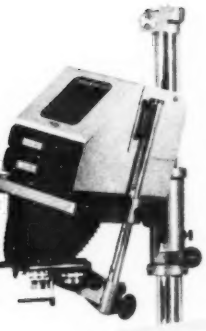
- **S-45 MODEL, with condensers for 4 x 5 negatives, less lens**
- **S-45 MODEL, complete with Schneider Componon f/5.5, 150mm lens**

Get more information. Circle 506, page 91

...orator is... *Special!*



• **Horizontal Positioning to Left or Right . . . Automatically . . . For Mural-Size Enlargements!** A special "lock-in" adjustment pre-sets any of the three 90° positions for instant positioning at standard angles. A loose or "free" setting permits shifts to any desired fix. 4 casters on the base provide complete mobility in the darkroom, and these casters are grooved so that entire unit may be mounted on rails for horizontal projection.

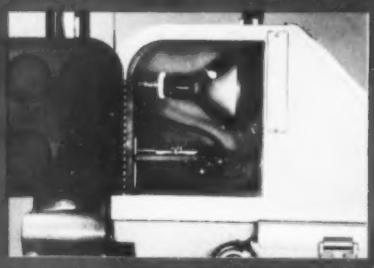


• **Unique Tilting Baseboard Allows Full Distortion Control!** Made of ultra-durable, non-warping laminated plywood the baseboard is attached to an arm by means of a totally new ball-and-socket suspension system. One of the greatest aids ever designed for the professional enlarger, this permits the baseboard to be tilted in any direction . . . locked in any position . . . and moved backwards or forwards along the baseboard arm to allow the center of the board to be brought into line with the optical axis of the enlarger. A three point bearing system keeps the baseboard in the normal position, parallel to the image plane, when engaged. The baseboard can be lowered all the way to the floor for maximum size vertical enlargements. Switch and power supply are built-in to baseboard.

• **Complete Distortion Control with Coordinated Reference Scales!** First, with the negative carrier—which permits raising of the negative with a special control knob . . . eloxadized scale indicates degree of tilt. Second, with the lens stage which swings from left to right with full control . . . an eloxadized scale indicates the degree of tilt. Third, with the unique tilting baseboard . . . the scale in the center of the baseboard in conjunction with the focusing aid on the negative carrier not only enables the center of the baseboard to be brought exactly into line with the optical axis but also serves to determine the degree of tilt in the baseboard. Finally, the enlarger head tilts up to 90° . . . and a scale indicates the degree of the tilt. Recording the valuable information provided by these reference scales enables user to reposition for that duplicate ordered "**exactly** as before".

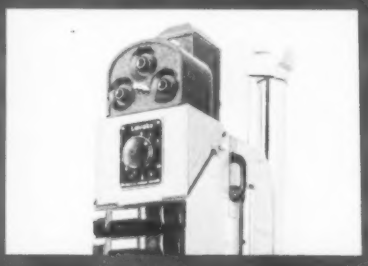
	CODE	NET USER PRICE
	LABSPEC	$575.00
nm lens	LABSPEC-150	$659.00

LIGHT SOURCES



TUNGSTEN . . . The ventilated housing has a door for convenient access to the lamp. Standard =211 (75 watt), =212 (150 watt), =301 (300 watt) opal enlarging lamps, and =302 (500 watt) with a cooling blower, can be used. Adapters are available for the use of projection bulbs as well as reflector floods. Easy lamp centering is affected by a tubular handle with knurled rings for positive grip and adjustment—another incredible Durst feature—which permits the lamp to be moved back and forth, up and down, in and out for minutest adjustment.

ACCESSORY COLD CATHODE GRID . . . for soft diffusion of color (use LACOLI–C) and black-and-white (use LACOLI–B) prints is also available. Used with the LACOTRA high tension transformer the DURST LACOLI COLD CATHODE GRID provides a soft, flattering illumination—without loss of sharpness. Suppresses spots . . . reduces retouching . . . ideal for situation in which pin-point sharpness is undesirable. It's high intensity light makes short exposure times possible even with slow papers. The LACOLI–C GRID for color is available in a color temperature of 3100° Kelvin. The LACOLI–B GRID features a 6400° Kelvin temperature. The same size as the regular condenser, the LACOLI simply slips into the lower condenser slot for full diffusion; upper condenser slot with power condenser in position for medium soft lighting.



DIAL-O-FILTER HEAD . . . a color-correcting device incorporating three dials that combine three basic filters (yellow, magenta, cyan) . . . to produce color densities from zero to 200 in all three colors for subtractive white light printing technique. Illuminated dials ease darkroom use. Light source: 250 watt projection lamp, 110 volts. Used with LAVARO accessory connecting head that adjusts the elevation of the color head to cover the full area of the varying film sizes used.

ALSO AVAILABLE—1000 WATT PULSE XENON LIGHT SOURCE, for color separations in the Graphic Arts Field. Write for details.

DURST LABORATOR S-45 DATA CHART

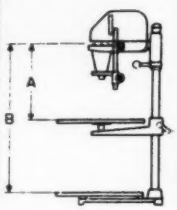
This comprehensive chart – actually mounted on the lamphouse – recommends condenser-lens combination

NEGATIVE — LENS — CONDENSER COMBINATION

NEGATIVE	LENS	Upper Cond.	Lower Cond.
4 x 5"*	6¼"	240mm	180mm
3¼" x 4¼"	5"	240mm	160mm
2¼" x 3¼"	4"	240mm	130mm
2¼" sq.	3"	180mm	130mm
35mm	2"	130mm	85mm

*NOTE—To use with 5 x 7 negatives simply change bottom condenser to 240mm.

DURST LABORATOR S-45 SPECIAL ENLARGING and REDUCING DATA CHART



LENS		MAXIMUM MAGNIFICATION		MIN. MAG.
		Pos. A	Pos. B	
50mm	2"	14.2	31	—
75mm	3"	8.2	19.2	0.40
105mm	4"	5.6	14	0.28
135mm	5"	3.6	11	0.40
150mm	6¼"	2.6	8.1	0.52

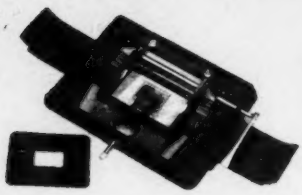
MECHANICAL SPECIFICATIONS

Baseboard Dimensions	23½"x32"
Height—Maximum Extension	7'4"
Net Weight w/Baseboard	140 lbs.
Gross Shipping Weight	260 lbs.

COMPARISON of DURST LABORATOR S-45 SPECIAL with competitive enlargers

FEATURES	DURST S-45	ENLARGER "S"	ENLARGER "B"
BELLOWS EXTENSION FOR REDUCTIONS	Built in (16½" extension for extreme reduction)	Additional Access.	Built in 13" extension
MASKING	Built in	Additional Access.	Not Available
DISTORTION CORRECTION	Built in (complete, in enlarger head, film-holder, lens stage and baseboard)	Additional Access. plus additional film holder	Built in (partial . . . tilting negative stage)
HORIZONTAL PROJECTION	Built in	Additional Access. and additional adapter ring	Built in
HEAT RESISTING GLASS	Built in	Additional Access.	Additional Access.
ADDITIONAL NEGATIVE CARRIER	Built in (by use of masking device)	Additional Access.	Additional Access.
CALIBRATED SCALES	Built in	Not Available	Additional Access.
ADJUSTABLE LIGHT SOCKET	Built in (complete)	Not Available	Built in (partial)
3-LENS TURRET	Built in	Not Available	Not Available
BASEBOARD LOWERS TO FLOOR	Built in	Not Available	Additional Access.
LIGHT SOURCE	Up to 500 Watt tung or 1000 Watt second pulse	150 Watt maximum	150 watt maximum
CONDENSER	Interchangeable (individually MTD in Cassette, insert in drawer)	Interchangeable (double MTD in spinning, screw in place)	Oversized (to cover all negatives as universal unit)
ENLARGER MOUNTINGS	Vibration free floor base stand MTD on locking casters, with individual leveling adjustments	Needs table	Needs table
MAGNIFICATION MAX. ON BASEBOARD 150mm LENS 135mm LENS 105mm LENS 75mm LENS 50mm LENS	 8.1 X 11 X 14 X 19.2 X 31 X	 6½ X 7⅜ X 10¾ X 14⅞ X 23½ X	 4¼ X 5 X 7 X 10 X 16 X
DIMENSIONS OVERALL HEIGHT BASEBOARD	 FLOOR TO TOP 7'4" 24" x 32"	 69" PLUS TABLE 18" x 34"	 52½" 20½x25⅜"

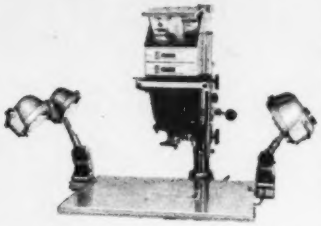
ACCESSORIES for the DURST LABORATOR S-45 SPECIAL



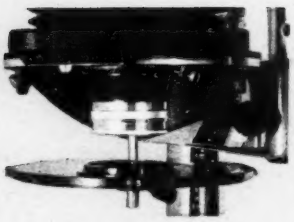
SPECIAL NEGATIVE CARRIERS

ROLL FILM NEGATIVE CARRIER, a special carrier for 35mm through 2½ x 3½ roll films (including 70mm films). Includes upper and lower cover glasses, focusing device, light traps. Also DIFOB and DIFMA masks for glassless enlarging of 35mm negatives. (Code: LADANE-70). For glassless enlarging of 2¼" sq. negatives, pair of AUMET-70 masks available.

LADANE (same as LADANE-70, but without focusing device and 35mm masks).



4-LITE COPYING LIGHTS, a nighty versatile copylight unit which consists of 2 supporting arms, 2 lamping bases, 4 lamp holders with individual switches and 4 light diffusing screens . . . graduated for even illumination on the baseboard. Special effects can be achieved by using color or polarization filters instead of the light diffusing screen. Functionally designed, the lamp arms swing away when not in use. (Code: RILU)

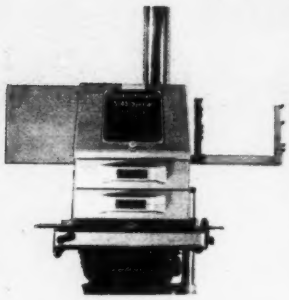


SPECIAL FILTERS & MOUNTS

4-FILTER TURRET WHEEL, special revolving four-filter disc (attached under lens)—used with 70mm (2¾") filters. Ideal for the following: 1) Color enlargements by the additive method; 2) Color separations in the Graphic Arts Industry; 3) Enlargements on variable contrast paper. Up to three supplementary filter discs may be mounted on axis. (Code: LATIRAD)

SPECIAL LENSBOARDS REQUIRED WITH DIFFERENT FOCAL LENGTH LENSES

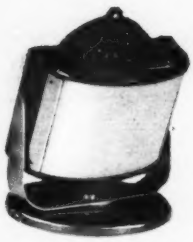
- Special recessed tube for 50mm lenses, w/Leica thread. (Code: LATUB)
- Special semi-recessed lensboard for 75/80mm lenses, w/Leica thread. (Code: SEIPLA-75)
- Protruding lensboard for 150 and 180mm lenses, w/Schneider thread. (Code: LAPLON)
- Flat lensboard for 210mm lenses, Schneider thread. (Code: LAPLA-S) (LAPLA lensboard with thread available for other make lenses).



DURST FILTRAMATIC-PAK

A complete rapid change filter pack for color or variable contrast black and white printing. Fingertip controls position the desired filtration between light source and optical system. Complete range of DURST/KODAK Color Printing Filters, consisting of CP 2.5, 5, 10, 20, 40, 50, yellow and magenta, are mounted in smooth-gliding channels for fast, positive operation.

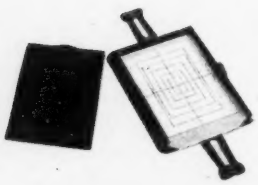
*A guide for approximate filtration on variable contrast papers is provided with the "FILTRAMATIC-PAK" (Code: FILPAK).



ADDITIONAL ACCESSORIES

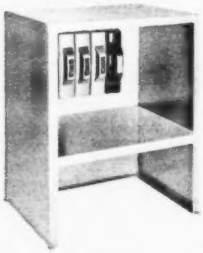
PENTACOLOR SAFELIGHT, an ingenious Durst design. Equipped with five interchangeable color filters: orange, light red, ruby red, pale green and white. Fitted into a turntable, the filters are instantly adjustable for the required light type. A heat absorbing filter prevents blistering or warping. Direct or indirect lighting available by swivelling the lamp in desired direction. For table or wall mount—it operates freely either way. Code: PENCO)

ENLARGER COVER, to protect enlarger against dust. (Code: LACUF)



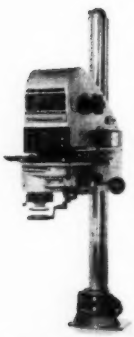
SPECIAL COPYING ACCESSORIES

COPYING CASSETTE, with precision-mounted ground-glass (with engraved grids covering film sizes from 35mm to 5" x 7"), sheet film holder for 5" x 7" and masks for smaller negative sizes. This copy cassette is inserted in place of the negative carrier. (Code: LAREP)



STORAGE CABINET TABLE, heavy duty cabinet and table for storing accessories. 4 slots keep additional condensers well protected and ready for instant use. A wide area is provided for holding paper or supplies so that everything is visible at a glance. Of welded sheet construction, the cabinet stands 30¼" high, 18" deep, and has a table top 24" wide. (Code: SYNBASE)

DURST ENLARGERS AVAILABLE FOR ALL NEGATIVE SIZES UP TO 8 x 10



Durst D-659
(70mm to 35mm)
twin-lens autofocus enlarger

Rapid change turret allows automatic focusing on baseboard up to 7x linear with 105mm lens; 16x linear with 50mm lens. Greater enlargements by rotating column for floor projection. Double condensers block mounted, self-masking negative carrier, built-in filter drawer.
Complete with Schneider Componar 50mm and 105mm lenses.
$419.50

Durst
Laborator 138S
(5 x 7" to 35mm)
manual focusing enlarger

Three-lens turret for 50 to 210mm focal-length lenses. Complete distortion control. Baseboard may be lowered to floor for maximum vertical enlargements. Horizontal projection. Built-in filter drawer. Interchangeable condensers. Double extension bellows. Built-in negative masks.
Complete, less lens.
$599.00

Durst
Laborator V-184
(8 x 10" to 35mm)
manual focusing enlarger

Versatile, compact... and at a cost far below comparable enlargers. Negative carrier accepts 8 x 10 negatives horizontally, vertically. Baseboard may be lowered to floor. Horizontal projection. Light source up to 1000 watts. Interchangeable condensers. Filter drawer. Built-in negative mask. Reference scales. Distortion control.
Complete, less lens.
Approx. **$2000.00**

Durst DURST (USA) INC., 1140 Broadway, New York 1, N. Y. Tel: MUrray Hill 5-0[illegible]35-6

Available only thru DURST Professional Franchised dealers

Printed in U.S.A.

Get more information. Circle 507, page 91

COMING UP

(continued from page 10)

Manhattan Chapter SRE Meetings every third Monday. Contact J. Ryerson, Joseph Dixon Crucible Co., Newark 2, N. J. Telephone DE 3-3000.

Midwest Industrial Photographers Association Contact John E. Scrage, c/o Deere & Co., Photo Department, 3300 River Drive, Moline, Ill.

National Visual Presentation Association, Inc. New York City. Meetings every second Thursday. Contact M. E. Shack, 19 W. 4th Street, New York, N. Y. Telephone MU 2-2294.

New York Chapter SPIE Meetings every third Thursday. Contact Don Bass, P.O. Box 177, Bethpage, L. I., N. Y. Telephone Liggett 4-8196.

New York City Chapter SMPTE Meetings first or second Wednesday of each month. Contact Ed Warnecke, Eastman Kodak Co., 342 Madison Ave., New York, N. Y. MU 7-7080.

New York City Chapter SPSE Monthly programs. Contact Richard H. Haard, Bell Telephone Labs., N.J., CH 3-1000, Murray Hill Ext. 2182.

Northern California Chapter Biological Photographic Assoc. Meetings every 4th Friday. Contact Cecile D. Kinney, U.S. Naval Radiological Defense Laboratory, San Francisco, Calif. Code 227 MI 8-6900 ext. 564.

Rochester Chapter SPSE Second Thursday. Contact Woodlief Thomas, Jr. Color Technology Division, Building 65, Kodak Park, Rochester 4, N. Y. Telephone CO 6-2500.

Rocky Mountain Industrial Photographers Meetings every fourth Monday. Contact P. H. Broadie, 2170 S. Lincoln, Denver 10, Colo. PEarl 3-2200.

Southern California Chapter, Biological Photographic Assoc. Meetings every third Thursday. Contact Avis Gregersen Warner, Box 78, 1200 N. State St., Los Angeles 33, Calif. Telephone CA 5-3131 ext. 7-1319.

Southern California Chapter SPSE Meetings the last Monday of each month. Contact Ben Augustine, 235 Annandale Rd., Pasadena 2, Calif. Telephone MU 1-0076.

Southern California Chapter Industrial Photographers Meetings every third Tuesday. Contact Janet Marshall, Executive Secretary, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614.

Get more information. Circle 487, page 91 ➤

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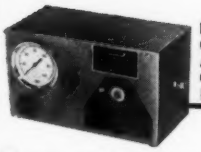
GAS AGITATION SYSTEMS
for every process



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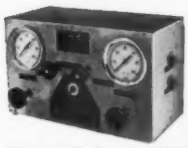
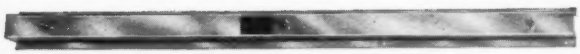
Provides "At-Station" pressure regulation with differential pressure control for agitation system. Features all pre-set burst cycles for color paper and films as well as B & W materials.



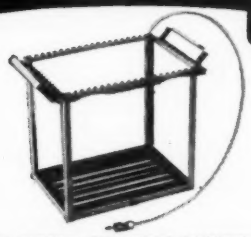
ROLOR GAS/AIR PRESSURE AND TIMING CONTROL UNIT—MODEL AC

"At-Station" working and differential pressure regulation for both nitrogen and compressed air. Offers a full selection of correctly timed pre-set burst cycles and continuous.



ROLOR GAS MANIFOLD—INJECTION TYPE MODEL GM

Stainless steel 5" raceway designed for wall or sink backsplash mounting, fitted with 3 spaced injection type, automatic gas flow control valves.



ROLOR FITTED CUT FILM HANGER RACK MODEL CH-3

Combined with Rolor Control Units and flow valves, the fitted film rack provides the highest degree of burst uniformity.

ROLOR GAS INJECTION FLOW VALVE STATION MODEL V

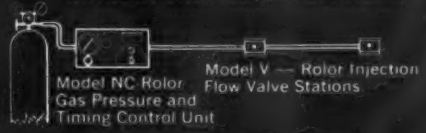
Insertion of jack-fitted distributor feed-lines activates valve for a positive full gas flow. Removal accomplishes a complete cut-off.

The components of the ROLOR Gas Agitation Systems completely satisfy the need for precise control of the factors that determine the degree of agitation uniformity: namely, gas pressure, cycle timing, flow control, and distribution. The quality units offered by ROLOR are identical in function to the time-proven components of the integral gas agitation systems used in the popular ROLOR Color Processors.

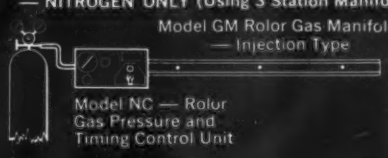
Write today for literature and complete information on how ROLOR Customized Gas Agitation Systems can be added in your processing laboratory.

DIAGRAM OF TYPICAL INSTALLATIONS

INJECTION TYPE INSTALLATION
— NITROGEN ONLY (Using 2 Valve Stations)



INJECTION TYPE INSTALLATION
— NITROGEN ONLY (Using 3 Station Manifold)



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The Nega-Viewer now makes possible the **instant** viewing of your negatives as enlarged **positives** . . . with control of brightness, contrast and image size.

Applications are unlimited in the fields of photo-instrumentation, data assessment, industrial photography, and microfilm/data processing applications. The Nega-Viewer provides a means of viewing, frame by frame, stills, motion pictures and sequence camera shots immediately, without the delay of waiting for positive prints.

The Nega-Viewer is a completely self-contained unit, requiring no additional amplifiers, power supplies, etc. A "negative/positive" phase-reversal switch also permits negative viewing, allowing viewing of color positives as positives.

Write for additional details and complete technical data.

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Get more information. Circle 476, page 91

LETTERS

To the Editor:

Reference is made to [the article *Are You A Dip & Dunk Photographer?*] column 3 page 90 of your October 1959, issue. Here you, or Prof. Bowman, mention reels and reel loaders that "permit batch handling of 8-in. paper in lengths of 20 ft. or less. A standard 8 x 10 3½-gal. developing tank accepts one of these reels . . ."

I am unable to get information as to where or how such reels may be obtained. Can you clarify?

Further, in the same column, you mention Saran processing baskets: "One unit on the market processes 30 sheets of paper in a 3½-gal. 8 x 10 tank."

Again, I have not been able to get information of these Saran baskets.

Any leads that you can give me as to these reels and baskets would be greatly appreciated.

Jack B. Keerl
Seattle, Wash.

The following equipment, referred to in the article, may be obtained through a franchised Eastman Kodak dealer.

Kodak Processing Reels, 8-in. rolls (for Kodak Color Print Material)	**$22.50**
Kodak Processing Reel Holder	**$5.45**
Kodak Processing Reel Loader, Model 2	**$72**
Kodak Saran Processing Basket (for sheet Color Print Material)	**$87**

To the Editor:

Acting on a suggestion made in Mr. Eisendrath's column [June 1961, page 10] concerning the use of a "Hailer" or battery-operated megaphone on industrial jobs, I set out to buy one for the purpose.

Instead, I ended up by purchasing a pair of Citizen's Band Transceivers to use for two-way communication while on location. These amazing devices operate on Short Wave with an effective radius up to one mile. No license is required.

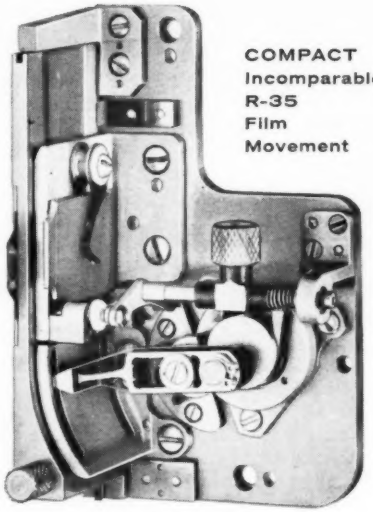
The type I have are made by Radio Manufacturing Engineers, a subsidiary of Electro-Voice Corporation. They are hand-held and are a little smaller than a carton of cigarettes. They come with a carrying case to go over the shoulder and are

(continued on page 22)

NEW MITCHELL R-35

...only truly professional portable reflex motion picture camera

Designed to cover the widest range of professional motion picture applications, the all new Mitchell R-35 reflex camera offers remarkable versatility to exceed the requirements of most discriminating cinematographers. Streamlined design is combined for the first time with the full range of professional features by Mitchell—world's leading source of truly professional motion picture cameras and equipment.



COMPACT
Incomparable
R-35
Film
Movement

Designed to produce rock-steady films completely compatible with those of the well-known Mitchell BNC, NC and Standard cameras, the new R-35 dual register pin movement features: Twin registration pins . . . twin pull-down claws; stop-motion to 120 F.P.S.; removable aperture plate with built-in filter holder slot . . . holds two thicknesses of gelatin filters. Full size: 0.980″ x 0.735″, removable pressure plate, entire movement removable for cleaning . . . special construction insures foolproof insertion with no loss of timing.

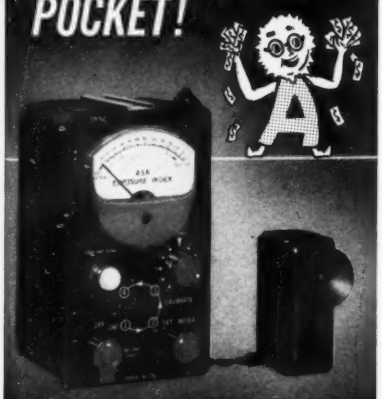
Hand Held or Tripod Mounted, the new Mitchell R-35 reflex camera uses a new series of Super Baltar matched lenses designed specifically for the R-35 by Bausch & Lomb. For Complete details of the outstanding features of this remarkable 35mm camera, write for the new R-35 Bulletin.

MITCHELL R-35

MITCHELL CAMERA CORPORATION
666 W. HARVARD ST., GLENDALE 4, CALIF.
TECHNICAL REPRESENTATIVE:
521 FIFTH AVE., NEW YORK 17, N. Y.

Get more information. Circle 462, page 91

PUTS GREATER PROFITS IN YOUR POCKET!



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INTEGRATING LIGHT METER

ends costly waste of time and film... assures perfect exposures the first time...everytime!

On location—in your studio—let the Ascor Integrating Light Meter put an end to "exposure uncertainty", once and for all. This battery operated, portable (only 3 lbs.) unit accurately measures the total light in a flash (so sensitive it measures the small amount of light neded to expose film with speeds of up to ASA 400).

The Ascor Meter is normally used to measure the light at the ground glass of the camera, thereby taking into account f-stop, bellows extension, lens transmission, etc. Accessories make it possible to measure incident light and to get the probe into very small areas.

Priced at $280.00 at Authorized Ascor Dealers, but as a time and film-saver, it will pay for itself in practically no time. Write for descriptive literature,

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Get more information. Circle 402, page 91

Edward R. Farber

ELECTRONIC FLASH

Heat, coherence, bargains, baby in the bath, slow-up for speed

The long stretches of high humidity summer weather cause many a triggering problem with electronic flash units. We have mentioned this problem time after time, but it still is forgotten and obscure, since it is so seasonal.

If you suffer from erratic flashing, slow recycling, insensitive photocell triggering and the like, and are certain that connections are complete and electrically sound, be sure to consider the possibility of leakage currents in the insulations of cords, plugs, shutters, and connectors. Oven drying and the use of silicone greases on insulating surfaces is called for.

Masers, lasers, colidar

The use of flash tubes in so called masers or lasers to excite synthetic rubies which in turn emit beams of coherent (monochromatic, mono-phase) red light, is creating an entirely new demand and new type of interest in electronic flash. First applications were in the field of long-range light-beam communication, but it now appears that the light beams can be used in optical ranging (a type of radar) called colidar—coherent light detecting and ranging.

All this interest can mean a great deal of research will be expended on the electronic flash itself—certain to pay some dividends in the form of improved photoflash equipment. Hughes Aircraft, Bell Labs, and Raytheon, are among those doing serious work in the field.

Components

For do-it-yourselfers who are building a special flash unit of their own, the General Electric Company, Photolamp Department, Nela Park, Cleveland, Ohio, has a two-page list of suggested suppliers of components, from reflectors to trigger coils.

A number of readers have asked where to obtain the G.E. Flashtube Manual. Write to the above address for any information regarding flash of all kinds.

Lewis F. Garber, writing from Pasadena, Calif., suggests Aerolux Light Corporation, 655 Eleventh Avenue, New York City, as another supplier of special flash tubes.

Classics at 30¢/ws

Industrial photogs will find some very good buys in the way of used flash units in the shops where portrait flash equipment is handled. Many early pieces of studio equipment used high voltage flash tubes of 2000 to 3000 volts, some of the sealed-beam type. These AC units are perfectly sound, but are being replaced with more efficient low voltage flash tube types with push button intensity controls, better reflectors, etc.

For action stopping industrial uses, though, the early units are useful indeed, and sell for as little as thirty cents a watt-second. If you do have some of the early equipment yourself, it will pay to snap up the similar units for the spare parts alone. Check your supply house occasionally. As the radio announcer says, you'll be glad you did.

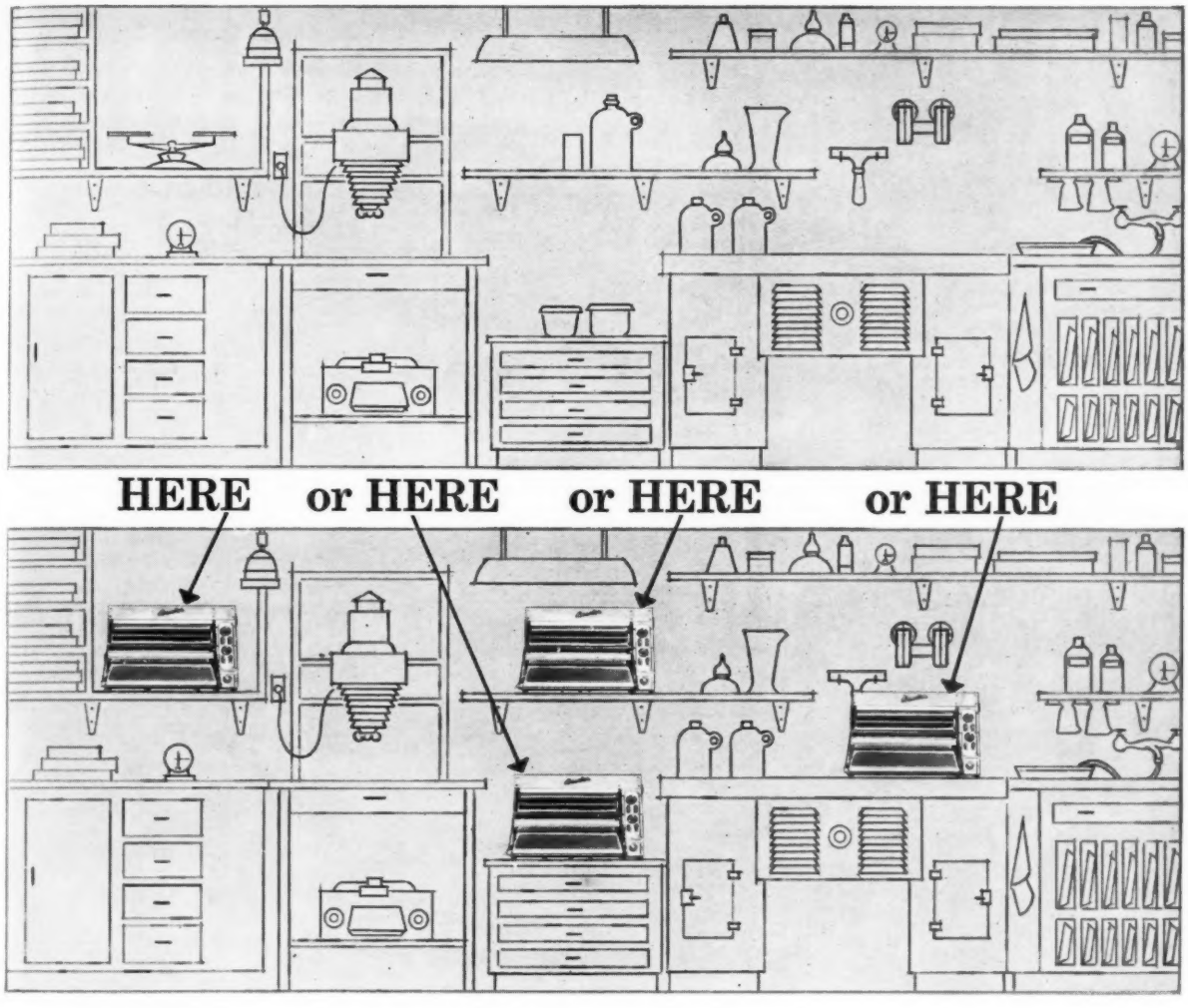
Speaking of used equipment, though, reminds us that some makes use OA4G or 1C21 trigger tubes. The replacement of these should be made with tested tubes secured from the manufacturer of the flash unit or competent repair services. Tubes taken from the shelf stock of an electronic supply house will not always perform properly. Selected tubes are required.

Gamesmanship

When salesmen show sample color slides taken with flash unit X purporting to show how much light it puts out, and how even the reflector is, beware of shots of baby

(continued on page 22)

WHERE IN THE WORLD can I put an automatic dryer?



If it's a Beseler Automatic Rotary Dryer

The smallest "BIG" dryer made—

- Needs only *2 feet* of shelf space
- Drys up to 60 single weight 8 x 10 prints an hour—glossy or matte
- Takes prints 16 inches wide
- Drum made of seamless thick copper lined stainless steel
- Fold-away apron retracts for dust-free storage
- Uses double heaters for perfect temperature control
- Has belt-free trouble-free *direct* motor drive
- Special terminal timer cools drum before turning off

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Beseler Dryers

CHARLES BESELER COMPANY, 241 South 18th St., East Orange, New Jersey

The 1217K Beseler Automatic Rotary Dryer

No other dryer does so much—so well—in so little space. The best possible choice for the small studio or photographic department.

Price $395.00
$405.00 Denver West

Get more information. Circle 411, page 91

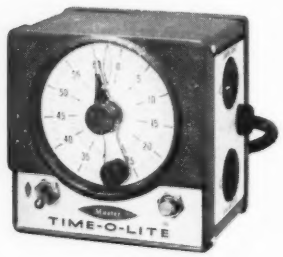
IN THE DARKROOM
TIME
IS OF THE ESSENCE

The timer . . . control center of the darkroom!

Yes, whether you spend hundreds, or even thousands, of dollars on your darkroom equipment . . . the preciseness of your results are dependent on the accuracy of your timing device.

For this reason more professional darkrooms are equipped with Time-O-Lite than any other timer (next time you're in a darkroom check the name on the timer). The product of over 20 years of design and manufacturing of industrial timing controls, Time-O-Lite is not just a timer . . . but a precision, electrical timing instrument guaranteed to give you years of dependable service (they just never quit!). That's why . . .

IN YOUR DARKROOM
TIME
·O·LITE*
IS OF THE ESSENCE



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Please send information on Time-O-Lite Electrical Timing Instruments . . . as well as Footswitches, Voltage Regulators and Printers.

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Address_____
City_____
State_____

Get more information. Circle 447, page 91

ELECTRONIC FLASH

(continued from page 20)

in the bath tub. The white bathroom, only a few feet square, is bound to give even lighting and permit stopping down at least two stops vis-a-vis a grass covered football field.

Another good way to gain speed the easy way, especially when larger lens openings are possible, (such as with greater distances in large rooms), is to shoot at very slow shutter speeds. This permits great pick-up from the existing light. It might be said that the shutter opens, prefogs the film, the flash occurs, and the film is postfogged. This technique gives at least an extra stop, and much better shadow detail, yet can be misleading about the actual light output or reflector distribution.

Reciprocity failure data

Problems of reciprocity failure with color still haunt many. Ansco puts out a good list of recommended filters and corrected guide numbers. Another list—Bulletin #7a—is available from Chadwick Helmuth Company, Monrovia, Calif. Though it refers to their Strobex unit in particular, it does list corrected ASA film speeds for 50-microsecond durations.—THE END

LETTERS

(continued from page 18)

very light in weight. They use a collapsible whip antenna a little over three feet long. Power is supplied by two small batteries in each unit.

While I have yet to put these to use in the field, I am certain they will prove to be great time-savers, and I can recall many instances in the past when they would have been extremely helpful. In my opinion, they are a "natural" for the on-location photographer.

Stephen W. Plimpton
Boston, Mass.

To the Editor:

Can you furnish information as to the manufacturer of the negative-positive viewer in which a negative is inserted and a positive picture is seen in the viewer?

Earl Payne
Sacramento, Calif.

The unit to which you refer is probably the Vertoscope of C. P. Goerz American Optical Company, In-

(continued on page 103)

FOR MAKING PRECISE
PRINTS
ON NEW FAST PAPERS

. . . the new, improved TIME-O-LITE P95 PROFESSIONAL PRINTER is a **must!** A new timing panel incorporates the most advanced timing mechanism available. Precise exposures as short as ¼ second are possible, within plus or minus 10 milliseconds. And adjustments of up to a maximum of 15 seconds can be made with no loss of accuracy!

In addition the new P95 PROFESSIONAL PRINTER lets you — **Get perfect exposures every time** . . . a built-in precision timer automatically turns on printing lights and red pilot light at platen is closed . . . turns off lights and pilot after pre-set time. **Adjust light intensity for various negatives** . . . handy control on front adjusts Kelvin temperature of lamps to intensity best suited for each negative. **Diffuse dense spots on negative out of final print** . . . diffusion control knob instantly raises or lowers opal diffusing glass (no shelving necessary). **Buy one printer for a lifetime of use** . . . built of heavy gauge steel and finished to last.

As easy to operate as the simplest printer . . . offering results as precise as the most complex printer . . . that's why . . .

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TIME
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IS THE ONLY CHOICE!!

NEW! TIME-O-LITE PRINTER MODEL P-95
Designed for printing on today's fast papers . . . built-in timing panel permits exposures as short as ¼ second (adjustable up to maximum of 15 seconds) with accuracy of ±10 milliseconds.

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Please send information on Time-O-Lite Printers . . . as well as Electrical Timers, Footswitches and Voltage Regulators.

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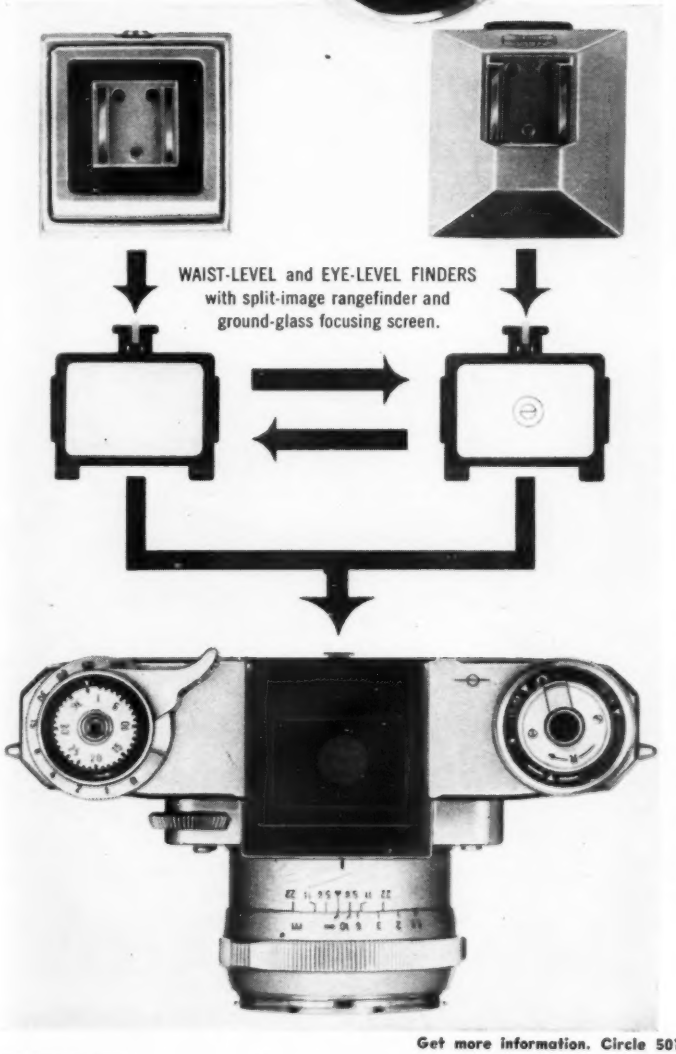
Get more information. Circle 504, page 91

Most advanced system of 35mm photography

ZEISS IKON

CONTAREX Special



With this new camera you'll cover an amazing variety of assignments. The pictures you take will be tops—because in every instance it enables you to use the ideal technique for the task in hand.

Its unique finder system permits eye-level or waist-level viewing, using split-image rangefinder or full ground-glass focusing screen. Image is exceedingly sharp—bright to the corners.

8 interchangeable world-famous CARL ZEISS LENSES

Biogon f/4.5, 21mm
Distagon f/4, 35mm
Planar f/2, 50mm
Tessar f/2.8, 50mm
Sonnar f/2, 85mm
Sonnar f/4, 135mm
Sonnar f/4, 250mm

New ultra-fast f/1.4, 55mm Planar

Micro and macro photography require but a few simple accessories.

Focal-plane shutter has 12 speed settings from 1 to 1/1000 sec. and B—all on a single dial; also self-timer. Fully synchronized. Each speed color coded; synchronization adjusts automatically as a speed is selected.

The Contarex Special is rugged and dependable. Its parts are finished to an accuracy of 1/25,000 in. Each camera must pass 80 tests, including operation in relative humidity of almost 100% at 105°F and a low-temperature test of −76°F.

See Contarex Special soon at your Zeiss Ikon dealer's.
Write for literature
CARL ZEISS, INC., 485 Fifth Avenue, New York 17

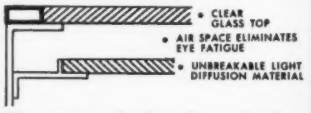
Get more information. Circle 501, page 91

IT'S A LEEDAL LIGHT TABLE

THE TABLE THAT LETS YOU SIT COMFORTABLY AS YOU WORK

Try it and *feel* the difference. Light box and structural supports are engineered to give you ample knee room. Install LEEDAL equipment for faster, fatigue-free working.

THE TABLE WITH AN EASILY REPLACED CLEAR GLASS TOP



Glass tops do break — do become scratched — do need replacing. LEEDAL tables use a clear glass top that can be replaced by any glass shop or hardware store.

Ask your graphic arts supply house for information on the complete LEEDAL line of temperature control sinks, layout and viewing tables, dot etch and ink-up tables . . . or write for catalog. E-185.

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LEEDAL

Get more information. Circle 453, page 91

Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

New Internegative film: superb color prints from transparencies

For all its fine work with original subjects, the Ektacolor positive-negative system has never been able to handle a print from a transparency very well for one or more of three reasons: the copying process produced too much contrast in the middle tones, too little contrast in the highlights or distorted color balance.

Attempts to counter these failures have proven inadequate or overly-complicated. The simplest approach has been to illuminate the transparency with electronic flash, and then underdevelop the negative. While this idea is satisfactory for duplicate transparencies, it does not work often enough with positive-negative to be truly fruitful. Flashing or fogging the negative helps improve the contrast situation generally, but only adds to the difficulty in degraded highlights. This calls for masking. We have gone so far as to make three highlight masks and three principal contrast control masks, finally exposing the negative with a tri-color exposure. At this point the signal advantage of the Ektacolor system over the Dye Transfer system, namely simplicity, is gone.

Good stuff

We are happy to report that a new material now makes it possible to get truly fine prints starting with a transparency. In fact, we can say truthfully that Kodak Ektacolor Internegative Film is a dream fulfilled for the color technician.

The long awaited sheet film is available in 4 x 5, 5 x 7 and 8 x 10. Actually, a bulk roll film in 35mm and 70mm has been available to photofinishers for several years. A processing license ($150) had to be purchased in order to buy the N-31 developer for the film.

The material is most unusual; there are 13 separate coatings and yet the material is sharper than Ektacolor shooting stock, which incidentally is priced the same as the internegative material. From the top down, the film contains: a gelatin overcoat • a blue sensitive layer • a high-contrast blue sensitive layer • a yellow filter layer • a green sensitive layer with a yellow colored coupler • another green sensitive layer • a high-contrast green sensitive layer • a gelatin coating • two red sensitive layers • a high-contrast red sensitive layer with a red-orange colored coupler • a subcoating • the film base.

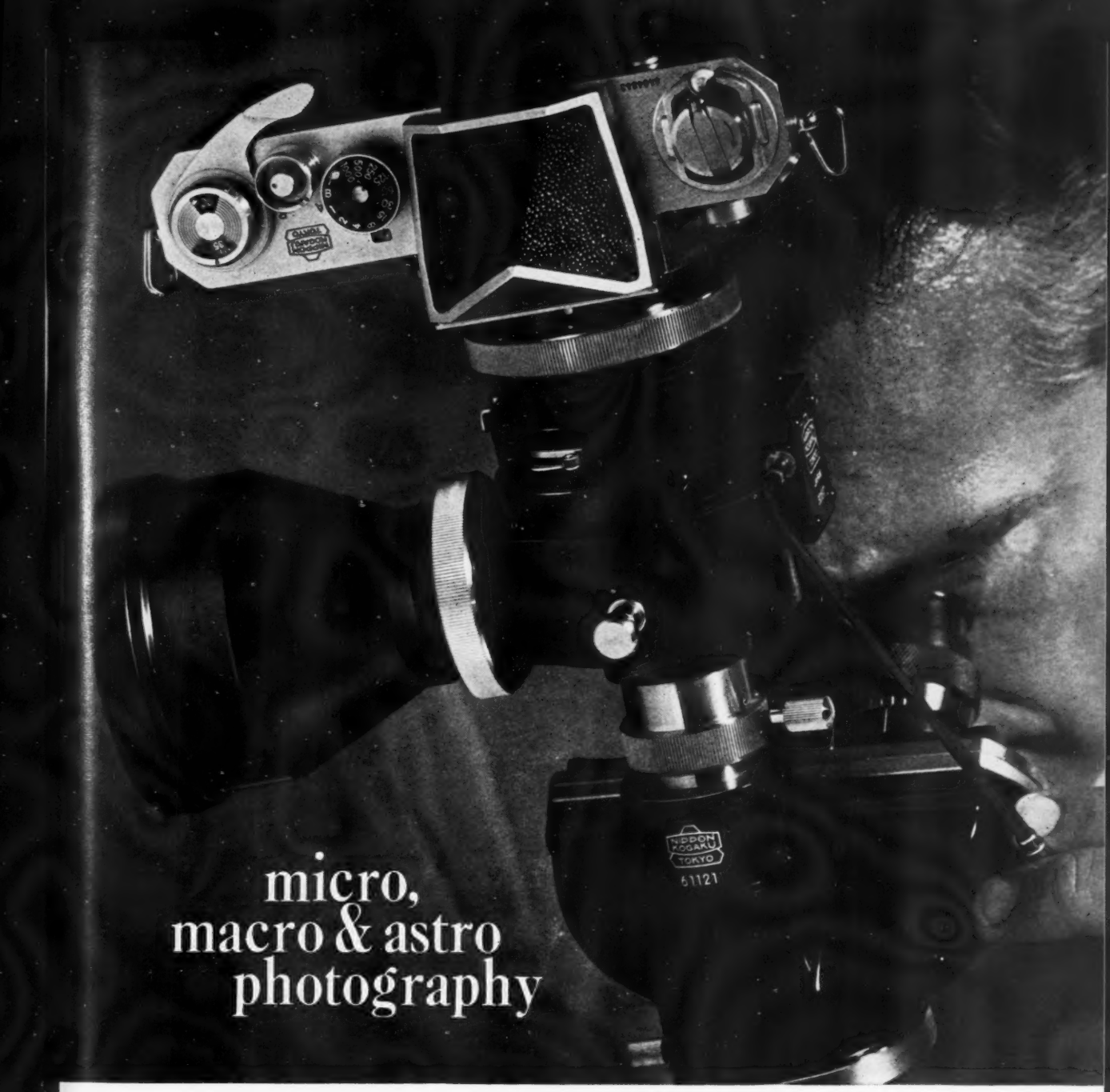
The sensitivity of the high-contrast layers is a good deal less than that of the low-contrast layers; thus they selectively record the highlight areas of the transparency, offering in a single film the effect of a highlight mask. The colored couplers handle principal and color control masking.

It ain't easy

Exposing the material is so critical it is not worthwhile zeroing in unless you have some volume of internegative work to handle. For one thing, the film is very susceptible to reciprocity failure except for exposures in the 3 to 16 sec. range. Mainly though, the slightest increase of exposure will up the contrast of the internegative, while decreased exposure will knock the contrast down. Contrast of all three colors must, of course, be in balance. This makes exposure tricky in the extreme, but it also provides a degree of convenient contrast control hitherto unknown—if you have the time, the skill and the equipment to keep the process in near perfect control.

A clever system has been devised for calculating the proper basic exposure. First move is to expose a photographic step tablet onto the internegative film. Then you read (with an electronic densitometer) and plot red, green and blue den-

(continued on page 26)

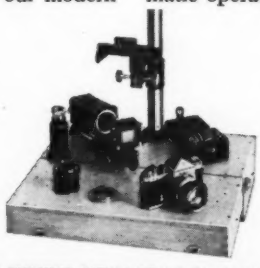


micro, macro & astro photography

exemplifies the almost unlimited versatility of the Nikon F

Even beyond its role as an art form, a news-gathering medium, a personal record of people and places—photography is a tool. And the Nikon F automatic reflex has become an invaluable aid to science, to industry, to education, and to countless other endeavors which make up the fabric of progress in our modern society and technology. For it is in this realm that the Nikon F reveals its fullest capabilities.

The Nikon F commands a complement of more than twenty interchangeable lenses upon which it can draw to meet the most critical and most unusual picture problems. And it is further implemented by an almost endless variety of accessory aids to fit it for photo micrography, macro and telescopic photography, and for every conceivable close-up and copy requirement. The scope and versatility of the Nikon F automatic reflex are virtually unlimited. Its picture capabilities extend from the infinitesimal to the infinite. A battery-operated motor drive can be used for completely automatic operation—in-hand or remote, wired or by radio control.



Any impulse can be used to fire the motor-equipped Nikon F, and any phenomenon can be used to originate the impulse. Rapid sequences, time-lapse and motion studies, automatic surveillance, data documentation—are a few of the more obvious applications. If you have a photographic problem you consider especially challenging, let us show you how capably it can be handled with the Nikon F. For further details, write to Dept. PM-9.

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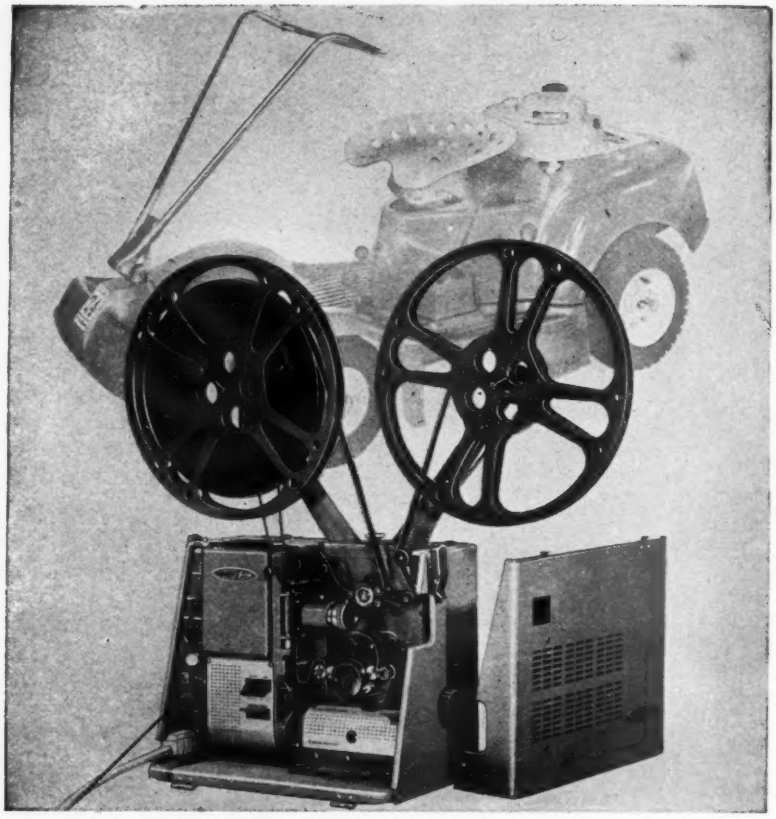

Kalart/Victor Projectors Help Sell Porter-Cable Suburban Riders

Porter-Cable Machine Company chose Kalart/Victor as the best possible 16mm sound projector for use by its distributors in presenting an important new sales film on riding mowers and tractors. Here's why:

1. Simple threading a key requirement. Porter-Cable needed a projector that can be threaded and operated by people with no previous experience. Kalart/Victor meets the need perfectly. It is threaded in 3 simple steps, with a color-coded path to show sequence and location.

2. Film safety important to Porter-Cable. No projector guards against film damage more effectively than a Kalart/Victor. Safety Film Trips—an exclusive feature—stop the projector in emergencies, before film is damaged.

3. Can it be set up anywhere? Porter-Cable likes the top-mounted reel feature of Kalart/Victor projectors. With both reels out of the way on top of the projector, any level surface may be used for setup. Projectors were made suitable for use even in small rooms since they were purchased with 1½" lenses instead of the standard 2" lenses.

What features are you looking for in a 16mm sound projector? Great picture quality? Magnificent sound reproduction? Outstanding durability? Adaptability for magnetic recording and playback? Kalart/Victor has them all—and more to boot. Call your Victor Dealer for a demonstration.

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50 YEARS OF PROGRESS 1910-1960 VICTOR

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INDUSTRIAL COLOR

(continued from page 24)

sities for each step on three separate sheets of paper. If your plot does not show a characteristic upsweep in the shoulder of each of the three curves, you begin anew giving the step tablet more exposure. Back on the track, you place the three plotted sheets on an illuminator. You shift them left and right and up and down (but avoid tilting them) until all three curves coincide. The red and green curves coincide readily, but the blue one is likely to deviate in the low densities, requiring some compromise. Finally you see how much displacement left-to-right is required (in Log E units) for each curve. This tells you how much filtration to add or subtract from your filter pack. For example if, relative to your starting point, it is necessary to shift the blue curve .3 units to the right, you add a 30Y filter to the pack. If you shift the blue curve to the left, you remove a 30Y filter or its equivalent from the pack. It sounds complicated, but in practice it is intriguing because it works beautifully. However, it must be repeated with each new emulsion number.

The system also works beautifully with reflection copy. We've gotten cleaner whites in copies of art-work than was ever before possible, even when using highlight masks with regular negative color shooting stock. Here you use an opaque step target.

The chemicals for processing the internegative are identical to the C-22 process, with the exception of the developer. It is made up of a special starting solution and stock replenisher. Replenishment is about 12 ounces per 80 square inches of film. It is necessary to use hanger separators and a well-tuned nitrogen burst agitation system in order to get even processing. Development is only 5 minutes; the hangers are reversed end for end after 2½ minutes in the developer. Control strips should be plotted after each batch. While the process requires careful work, it is not exasperating: our first mix of developer dates from February of this year and it has always been within the tolerance limits set by Kodak.—THE END

PMI DIRECTORY

Coming in October. Get a free copy with your subscription to PMI. See subscription order on page 91.

AT 5 P.M. a reduced-scale offset duplicating master of Sunkist's teletyped market reports is completed with Kodak Ektalith Processor, Model 20, (shown above) and process camera. Job took only 1½ minutes.

NEXT MORNING offset copies produced from Ektalith-made master are in hands of Sunkist packing house managers, and other field and district men. "Doc" Hasty of Upland Lemon Growers Association studies his copy.

Sunkist® cuts offset duplicating time and costs 50% with Kodak Ektalith Method!

Being able to make a high-quality offset paper plate in 1½ minutes helps speed communications on many jobs at Sunkist Growers, Inc., Headquarters in Los Angeles. Take one example:

Each day Sunkist sales offices throughout the United States and Canada send a stream of teletypes to Headquarters giving local market conditions. Included are wholesale prices for Sunkist fruit, estimates on supply and demand, and other data which will help decide where fruit will be shipped and related marketing strategy.

It's important that the day's round-up of these teletypes go post-haste to Sunkist packing house managers, field inspectors, district exchange offices and executive staff at Headquarters.

No problems! Just another routine job for Sunkist's duplicating department with the Kodak Ektalith Method.

In three simple steps: *Expose . . . process . . . transfer* . . . a 60% reduced-scale offset master is made from a paste-up of teletyped data. Time . . . just 1½ minutes! Such speed and low-cost offset plate-making (less than 30¢ per paper plate) are utilized by Sunkist on a variety of jobs calling for anywhere from 25 to 500 duplicator copies, Work includes making reduced, enlarged or same-size plates from correspondence, research studies, minutes of meetings, traffic reports.

Quality of the Ektalith-made plates—and the copies made from them—is rated excellent by quality-conscious Sunkist organization.

New free booklet shows in detail how you, too, can save with Kodak Ektalith Method. Write Eastman Kodak Company, Photo Reproduction Products Division, Rochester 4, N. Y.

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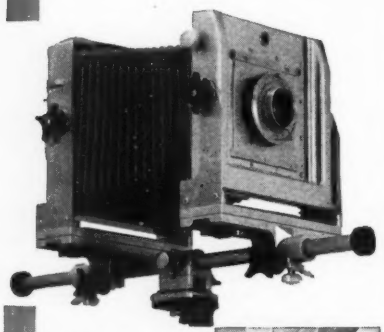

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Get more information. Circle 415, page 91

PMI IN-PLANT REPRODUCTION

Herbert P. Paschel

GRAPHIC ARTS

Basement photography, awesome curves, copy-to-print plate

A reader is puzzled because of a problem on which he has received some conflicting advice. He writes —"I wonder if I could get some advice on the advantages, or disadvantages, of having the darkroom and camera room in the basement of a building. I have been advised against this because of condensation, etc. I have also been told that a basement type darkroom is an advantage because it holds temperature the same most of the time."

No wonder this reader is confused when the advice he's been getting is based on generalities. It certainly isn't true that a basement area maintains uniform temperatures most of the time. The basement is the usual location for the central heating system and hot water generators and could thus be abnormally hot and dry during the heating season. Condensation could take place in any area where moist warm air comes in contact with cooler surfaces.

Whether or not a basement area is suitable for darkroom and studio use depends entirely on the overall physical conditions. But dampness is the most serious problem and must be avoided or corrected.

Basement dampness may be caused by condensation, but, to an even greater extent, by surface water or ground water. Surface water dampness results from the seepage of water into the basement from the ground surrounding the foundation. Ground water dampness is caused by underground seepage, springs or a high water table in the surrounding earth. Condensation, or sweating, occurs when warm humid air comes in contact with cold walls, cold water pipes or any other cold surface.

Seepage can be corrected by waterproofing the exterior and interior walls of the foundation and the floor. In severe cases it may be necessary to provide a network of drainage channels in the ground outside and a sump pump inside in addition to the waterproofing.

Condensation can be controlled by insulation. The concrete walls should be faced with a secondary wall made of insulating material with an air space between outer and inner walls. All exposed piping should be covered with asbestos air-cell insulation.

If you are having a building constructed, the contractor should take whatever steps are necessary to insure a dry basement. If you are renting, you had better get some competent advice as to the year round condition of any basement under consideration. A builder or architect can easily spot the signs of seepage, condensation, or even extreme dryness. If renovations are necessary, you'd better get a number of estimates on the cost involved.

While it is true that basement areas are likely to be cooler and less changeable than the upper floors of a building, you'll probably find it desirable, if not necessary, to provide air conditioning. Especially if you want to maintain uniform conditions within narrow limits. With a dry and well insulated basement the cost of operating the air conditioner will be extremely low. In any event, you'll need a good ventilating system.

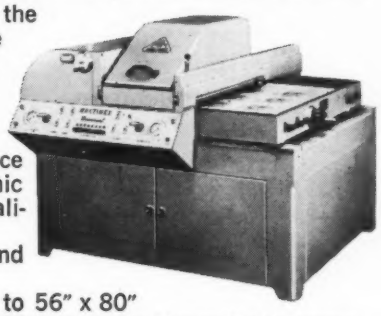
In my rounds as a consultant I have seen many basement laboratories—some good, some bad. The good ones, obviously, did not suffer from any of the problems mentioned above and were as efficient as in any above ground location.

The ABC of D log E.

If you've been puzzled by sensitometric terms, or the entire subject in general, you won't have to stay in the dark any longer. And your enlightenment won't cost you any more than the price of some

(continued on page 30)

MICROMINIATURIZE TO PINPOINT PRECISION
BY AUTOMATIC STEP & REPEAT ON THE ROYAL ZENITH MISOMEX



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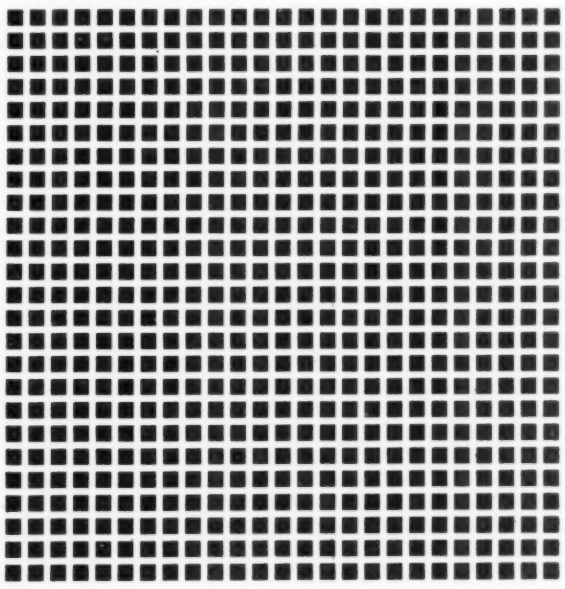

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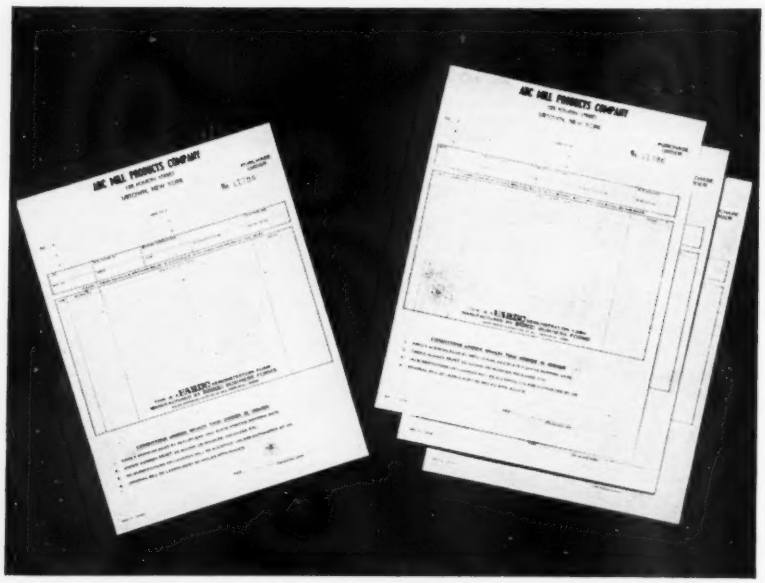
REPRODUCTION TRENDS



See how little difference can be noted between a nearly opaque original (left) and three fast, economical diazo copies (right) made with POST Super Vapo Black Paper.

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(continued from page 28)

stationery and a postage stamp. Just write to the Gevaert Company of America, Inc., 321 West 54th Street, New York 19, New York, and ask for—Sensitometry, #211.982. An interesting 21-page booklet will be furnished free of charge as long as the supply lasts.

Electrofax engravings

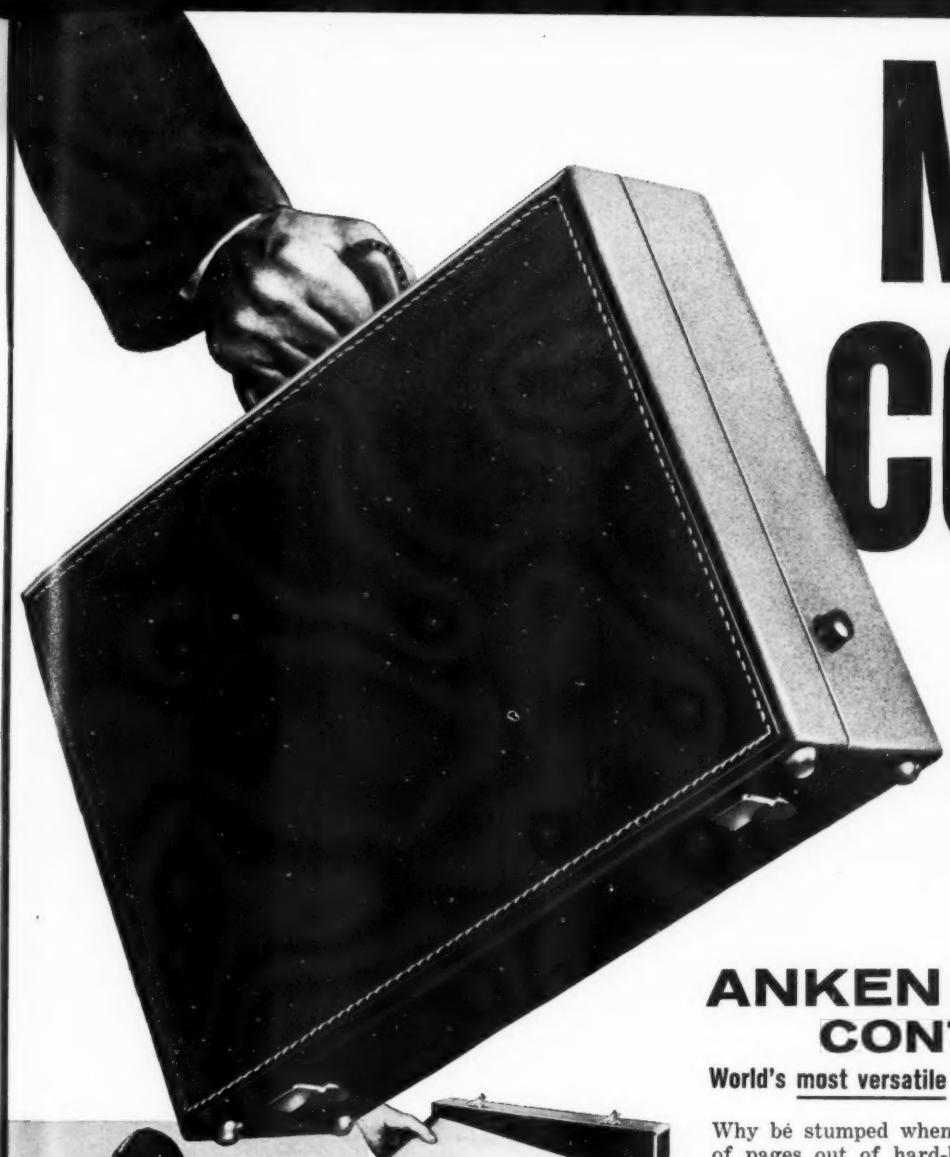
An extension of the Electrofax process to newspaper engraving plates was announced recently by the Radio Corporation of America. With the Electrofax process, conventional engravers zinc or magnesium plates are pre-coated with the Electrofax formulation to provide an electroconductive surface. This is a coating which will accept an electrostatic charge. In the charged condition the plates are light sensitive.

RCA intends to market the pre-coated plates which are made light sensitive, when needed, by means of a simple mechanically-operated device. The sensitized plate is placed in the focal plane of any suitable process camera and exposed briefly to any "hard copy" destined for publication. (Hard copy is a complete assembly of all copy elements in proper position and to scale. In the case of tone illumination this requires making a halftone negative in advance and inserting a contact screen print [Velox] in the paste up.)

This is thus a direct, copy-to-plate system in contrast to conventional methods which require separate negative making and plate exposing operations. Elimination of the film exposing, processing and drying steps, and the cost of the film itself, represents a considerable saving.

Following exposure the electrostatic image is "developed" by means of a suitable toner which, after fusing by heat, combines with the coating to form an acid resistant stencil. After the residual coating in the non-image areas is removed by solvent, the plate is ready for conventional rapid etch.

According to the announcement, the Electrofax technique could be applied to lithographic printing plates with equally good results. The method is also applicable to the production of phototemplates, widely used in the aircraft, automobile and shipbuilding industries. The making of nameplates is another application that suggests itself.—THE END



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Arnold Eagle

INDUSTRIAL MOTION PICTURES

Should industrial films ride the crest of art cinema's new wave?

In an earlier column I discussed the so-called "new wave" in the movies as well as some of the equipment that goes hand in hand with it. A cynical friend of mine remarked that the "new wave" is really not so new in industrial and commercial films. Some of these films, he said, have for years been using the cine technique of out of focus, bad photography and unorthodox editing.

Of course the idea in this new movement is not a bad technique for its own sake; but it is true that in certain circumstances a jerky and slightly out of focus picture will transmit more of a sense of reality, of emergency, of danger, to the viewer. In other words, it is more apt to convince the audience that the situation pictured on the screen really happened; and that the cameraman was lucky enough to catch it. This kind of effect is one of the highest achievements in film; an effect striven after by most directors working with slick theatrical techniques on movie stages, but very rarely achieved.

Some may question the relationship of the "new wave" in the entertainment film to the industrial and educational films that are the major interest of PMI readers. The fact is that every film, regardless of its category, purpose or length, must have some qualities and aims that are universal to be effective. Every film must have a construction that is visually attractive to retain the viewer's attention. Every film must be able to stimulate its audience intellectually or emotionally, or a combination of both.

Revolt against the revolting

The "new wave" in the entertainment film of which I wrote briefly in June is a revolt of young creative film makers from all over the world; a revolt against the traditional "Hollywood" type of picture which they feel has outlived its usefulness and is bankrupt. They are convinced, and with a great deal of justification, that these films are artificial, cliche-ridden, and a distortion of real life; and are sterile, boring and ineffectual. I cannot go into detailed specifics here, but I would like to make two points. First: the empty and half empty movie theatres bear witness to the fact that most of these films have lost their audience; a state of affairs that cannot be blamed entirely on the competition of television. And second, the average movie goer in Cambodia or Morocco who gets his image of America from the Hollywood film, got a distorted, unflattering and mostly false impression of America. He thinks America is populated with brutal gangsters and killers; or plutocrats who get into trouble because they don't know what else to do with their free time. We certainly missed the boat when it came to convincing the average guy in Pakistan, through our films, of the beauty of true democracy.

Eagle claws

Now, to come back to the correlation between the entertainment and commercial information films. I believe a "new wave" is needed badly in the latter field. Of course, it is true that we don't have to worry too much about losing our audience; the 16mm non-entertainment film never did get even a fraction of its potential in viewers. If we exclude a small number of films that land unheralded on the television screen, most 16mm information films reach a pitifully small audience. This is partly due to an inadequate distribution system; but for the most part, let's face it, most commercial films are uncreative, unimaginative, narration ridden, cliche cluttered, badly photographed, badly cut; in a word, bores—and boring even to the audiences they aim at.

(continued on page 36)

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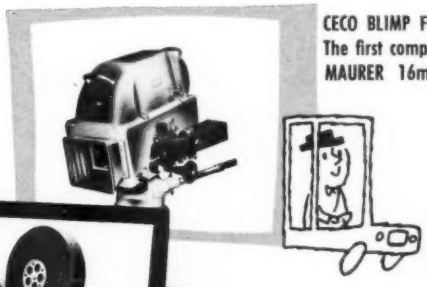

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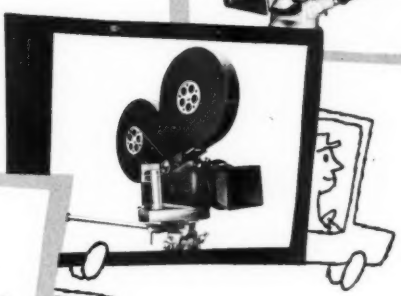

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- ☐ NOMAD Transistorized Sound Recorder-Reproducer
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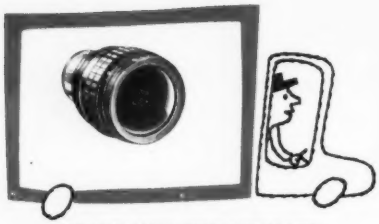

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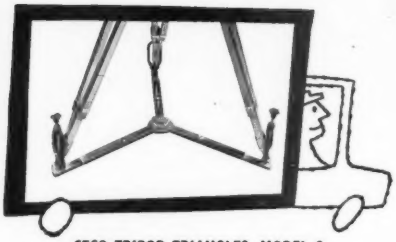

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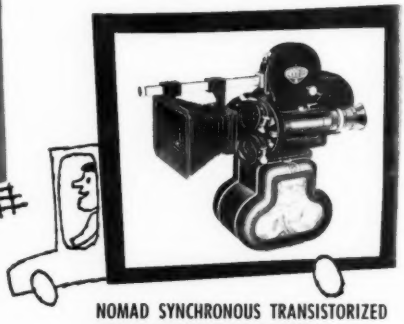

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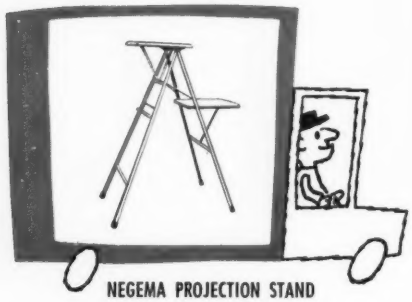

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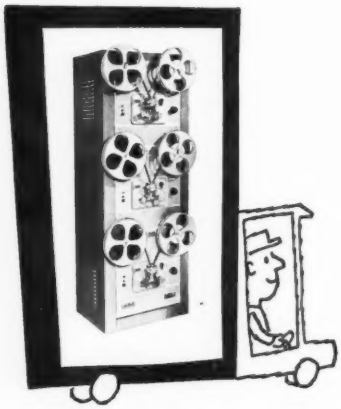

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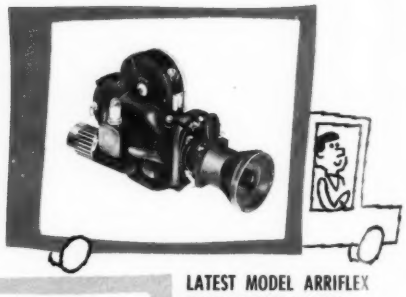

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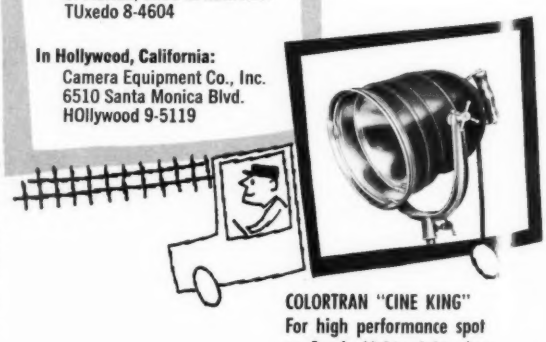

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PMI IN-PLANT REPRODUCTION

Vernon Tate

MICROREPRODUCTION

MEDIA—a relatively low cost approach to mechanized retrieval

Just as FileSearch can trace its immediate ancestry to the rapid selector, another newly announced system is clearly a lineal descendant of Minicard. MEDIA (Magnavox Electronic Data Image Apparatus) developed by the Magnavox Company of Fort Wayne, Ind., has been announced as a low cost unitized film document storage and retrieval system. The equipment has been shown publicly; demonstration and other projects are understood to be under way.

In the chips

MEDIA operates on the basis of a photographically produced film card, actually a piece of film 16mm wide by 32mm in length, which for the most part is produced, stored and manipulated by machine. On the film card two textual pages each up to 9 x 14-in. in size plus a coding field of up to 17 digits can be placed. The coding field is of particular interest, for it contains numbers large enough to be read by the naked eye and also the exact equivalents in code form for electronic reading. The film cards comprise the unitized feature of the system.

Numerical coding is the key to the application and use of MEDIA at the present time.

Each document to be reproduced is assigned an individual unique code number. Before the production process can begin, the code number must be assigned to the document. Before a code number can be assigned to a document, the entire records system which is to be recreated and used in this form must be studied and a coding system devised. The process is not always difficult. A file of numbered reports, for example, could easily be coded using the report number as the base and adding the page number of each page or enclosure. For our purposes, happily, we can assume that all of this work has been done.

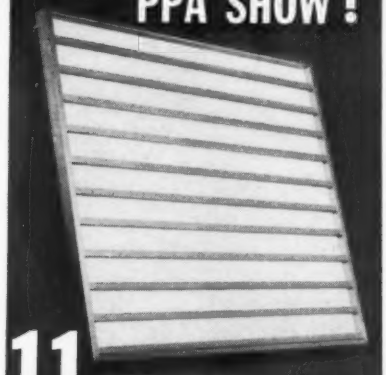
With the coding and number assignments out of the way, the first step in creating a MEDIA file involves a microfilming operation. A special 16mm roll film camera is used with a console so arranged that each document and its accompanying code number is photographed simultaneously. When a full roll of either 100 or 200 ft. is completed, it is processed. Processing facilities near the camera are a convenience, but there is no technical reason why the film should not be sent out for commercial processing which is usually cheaper. At the same time a safety or security print can be made.

The importance, incidentally, of making duplicate or positive security copies of important microfilm files has never received the attention that it deserves. In all too many instances valuable, even irreplaceable, negatives have been used in reading machines by unskilled or careless hands. They are often scratched or damaged beyond repair. This is very poor economy; camera negatives are costly. In addition to the expensive hand labor required to make the exposures, the originals must be put in order, brought to the camera, and after filming taken away again to storage. A duplicate negative or a positive print on the other hand is almost completely a machine operation. The principal expense is raw stock and processing plus a little machine time. No irreplaceable, valuable or permanent record microfilm negative should *ever* be used for anything except the making of a positive or a duplicate negative. If the project cannot stand the slight extra expense, it is either inadequately funded or not worth doing.

When the roll of negative is returned from processing it is fed through a cutter. MEDIA film cards produced at the rate of 250 per

(continued on page 99)

THE HIT OF THE PPA SHOW!



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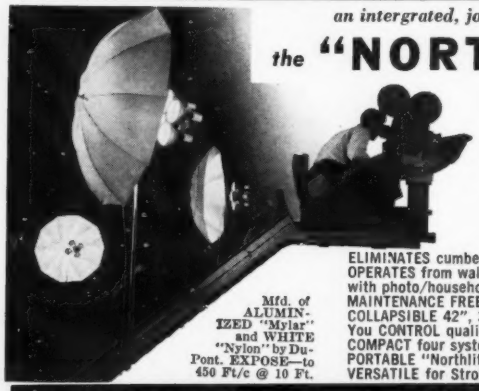

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IND. MOTION PICTURES

(continued from page 32)

There is no reason why a film on a specialized subject should not be interesting to a general audience. For example, take Bert Hanstrom's film on *Glass;* or On Film's production *Aluminum;* or some of Lewis Jacob's industrial films, as well as those made by MPO; or some of the documentaries of the Canadian Film Board; or the teaching films shot for the Physical Science Study Council in Cambridge. These film makers attempted, successfully, to find new and more effective ways to tell their stories. A new way to make information films is a must. The public taste is changing. It is becoming more and more resistant to the insistent sales pitch, to the hard sell. The public is exposed scores of times every day to actors on the television screen who try to sell them things they don't need; who make misleading statements and blare out half truths and downright lies with a straight face. The public is becoming jaded, and the words spoken on the screen have less and less effect upon the audience.

Neatness doesn't count

This is why I feel that we must search for new forms to enable information films to influence our audience. We must find a technique that will convince the viewer that our film is sincere and honest. More is needed than a well trained, smooth, sexy or forceful voice pouring out of the screen, telling us the "truth" and what is good for us. The narrated film, unless accompanied by forceful visual construction, is a wasted effort. The lip sync dialogue on the screen mouthed by obviously rehearsed actors has the same effect upon us as the smooth utterances of a pretty girl who looks straight at you as she points to a box in her hand and tells you, "Go out immediately and buy Tootsie Wootsie Opium. It is the best because a group of impartial experts has conducted tests and discovered that Tootsie Wootsie creates the most colorful dreams." The reason we do not rush right out to make the purchase may be that only five minutes ago we heard an even prettier girl tell us that the impartial experts found "Caramel Opium" the absolutely very best. So there you are, right in the middle of a quandary: which opium

(continued on page 102)

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Get more information. Circle 435, page 91

AN EDITORIAL

Contest Blues

Why do industrial photographers keep taking the same picture over and over again? Why do they parade as their best work the oil refinery at sunset, the white coated junior scientist framed in laboratory glassware, the work in the lathe gleaming with cutting oil as the tool curls off waste—when these are so patently cliches? We can suggest some plausible answers. As cliches, they are unquestionable. People like to pigeonhole pictures and this makes it easy for them. They're safe for other reasons. The subjects have scalpel edges and fine gradations, simplicity and drama. They show off technique to good advantage, and technique is the sine qua non of the professional. Furthermore, there's nothing to louse up the technique. You can't hardly miss, and even if you do, you can begin anew. It's like boiling eggs. ■ In short then, one good reason for the cliche is that it's easy. One bad reason for it is that it's a perversion. The point is not the refinery or the scientist or the lathe; the point is the technique, otherwise such pains would not be taken to make sure the scientist looks like every other scientist, the refinery looks like every other refinery, etc. Furthermore, not only does unoriginal work betray the subject, it betrays the photographer. Obviously he cannot be spending all his time shooting those lathes, unless he works for a lathe manufacturer. ■ Can we suggest a different approach? If the photographer is out to win contests, and if the stock shot will do it— the answer is no. The photographer is not at fault, the contest is; the photographer may as well knuckle under. Actually however we prefer the routine record shot done to perfection. Although it presents the same challenge, it is a good deal more purposeful. An honest job, done well, always does the heart good. The technical photograph is more challenging and likely more useful. The product picture, in context, is fascinating, as Sears has so clearly demonstrated. But industrial contest pictures seem to avoid these categories. They pretend to art, and, to our mind, they miss by a mile because art must be human, art must be original, and art cannot be sham.

The Editors

The McDonnell story is the solid, steady growth of a photographic section that has sought greater responsibilities in new fields, serving its company, which is the prime contractor of the Mercury space capsule. On the side, these cameramen also find time to develop gadgets and gimmicks to lighten the load on themselves and the drain on the corporate treasury

When Chief Photographer Chester Turk joined McDonnell Aircraft, St. Louis, in 1941, he *was* the photo section. It doubled the following year when Assistant Chief Photographer William Schmidt made his appearance. Today, there are thirty more people working with Turk and Schmidt, performing the variety of photo and repro services required in a company up to its afterburners in the jet and missile business. (McDonnell produces the Mercury space capsule, the F4 Navy and F101 USAF jet fighters.)

The remarkable thing about the growth of the Photographic Department is that it has been a steady process. There were no sudden expansions and equally sudden contractions typical of the mercuric aircraft industry. The reason can be found in the approach of the section to company needs.

The Photographic Department will accept any challenge from management, whether it involves making aerial films of test flights at 40,000 feet, supplying quick processing service for 70mm test film or making 20 x 24 color prints for executive offices.

The department is busy when business is good and even busier when business is bad. Explains Turk, "our work increases when things get slow because that is when the research and development people, large customers of photo service, increase their activity to try to get new business for the company."

The work load is divided about evenly between motion picture, still and graphic arts (reproduction). Currently, there are five men working on movies and three in the repro section. The rest of the section is assigned to color processing, clerical work and general still photography.

Photographic outposts

In addition to the main (#34) lab., there are two field labs at McDonnell's Lambert Field installation. These are small outposts designed to provide quicker photographic service for adjacent activities than would be possible from only one central lab. The #42 lab (named after the building in which it is located) is a three-man operation servicing flight tests and other activities in the area. The work load in #42 lab is largely still work, although there is a Bolex H16 with three lenses, 13mm f/2.5 Elgeet, f/1.8 Retrofocus Angenieux and 75mm f/2.5 Cine Tele-Raptar. The #102 lab is a one-man operation servicing certain engineering functions. If the men from these labs are not available, photographers will be sent out from the main lab. These labs were established when the main lab was moved to its present location in 1957. McDonnell also keeps a man at Edwards Air Force Base to cover flight tests.

McDonnell photographers have been in the movie business since 1948. As part of their government contracts, the company had to produce film reports on the project. The footage for these reports was shot by outside cameramen hired on a daily basis.

Despite the expensive talent, Turk felt that McDonnell wasn't really getting the best coverage possible. He showed management comparable footage shot by the

outside movie photographers and by the in-plant cameraman. The result? A clear victory for the in-plant crew.

This was not unexpected since the in-plant people were more familiar with the plane, the test procedures and the type of coverage needed. Turk cites the case of an outside cameraman who spent two days at the plant and failed to come up with a single foot of usable film.

Since then, there has been a steady expansion of movie activity. Last year, 51 films were completed, ranging from short engineering test reports to public relations-type films for general release. Not all of the 51 films were started last year, of course. Some, completed in 1960, were started in late 1959.

The movie equipment inventory includes a variety of models, from a small N-6 Gun-Sight (GSAP) camera to a Mitchell mounted on the animation stand.

An Arriflex is used for sound footage while two Cine-Specials are available when a light portable camera is needed. Bell and Howell is represented by two 70DL's, plus two Traid Super Speed conversions. There are four Fairchild Flight Analyzers, a photogrammetric-type camera giving digital and graphic data on take-offs and landings. Several Fastax cameras are used for test purposes, being kept in the equipment crib for use by engineering test personnel. A Bolex and two K-100's are used for general coverage.

The handy GSAP

Perhaps one of the most underrated cameras around, according to Bill Schmidt, is the GSAP camera. These 16mm magazine-load models were built by the thousands and mounted in aircraft for recording the effectiveness of the plane's guns. Motor-driven from the plane's electrical system, they would begin recording when the pilot pressed the trigger to fire his guns. After the war, they were available as surplus for less than $10 each.

However, they were unsuitable for most civilian uses unless they were converted to spring wind or to use batteries. Also, some were really war casualties and should have been permanently retired.

At McDonnell, these cameras are perfectly suited to recording flight tests. They were adapted to take standard C-mount lenses. The internal heater system and the fiducial mark in the frame were also removed. Mounted on wings, instrument panels and outside body surfaces, they film every phase of the grueling tests that every plane undergoes during development.

The most unique mount of all was developed by a late test pilot, Zeke Huelsbeck. He pointed out the value of the GSAP camera when he brought a helmet camera that he designed into the photo lab.

On one side of a plastic pilot's helmet was a gun-sight camera with a standard 1-in. lens. On the other side was a small battery motor. A flexible shaft extended over the top of the helmet, joining motor and camera. The pilot could turn his camera kibitzer on or off as he desired to photograph everything in front of his face.

Many fine aerial scenes were shot with this camera. The pilot could fly close and not worry about having to handle both plane and camera. He could follow a plane with flight merely by turning his head.

Most aerial missions, however, are flown in two-place fighters, the photograher occupying the radar observer's position, slightly above and aft of the pilot. The cameraman will carry one camera in his lap and another on the floor between his feet.

If movie coverage is desired, a Graphic will be the camera on the floor with a movie camera in his lap. For still coverage, the camera positions are reversed. For stills, the Graphic is used. For movies, the camera may be a Bell & Howell Filmo, an Arriflex or a hand-held GSAP camera with extra film magazines in every one of the flying suits' umpteen pockets.

Pictures are made at the working altitude of the plane being tested, upwards of 30,000 feet. At that height, the light is uniform and quite strong, permitting exposures of f/8 or f/11 at 32 fps. If necessary, an exposure is checked with a Sekonic meter and the proper slide for direct reading.

Prizewinning film

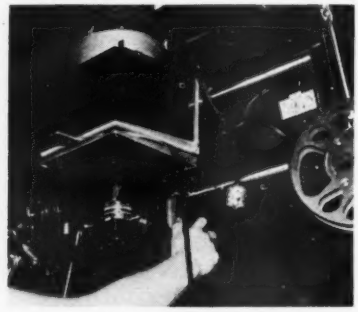
Perhaps the most impressive product of McDonnell's film schedule is a 13-imnute animated film, *Man In Space*, a fascinating account of a manned space capsule (McDonnell made the Mercury capsule used by Cdr. Sheppard).

GIMMICKS AND GADGETS: MOVIE

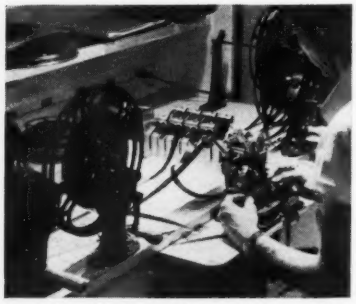
Prize gadget is animation ring which permits movement of subject cel without moving background cel.

Gun camera on helmet, designed by test pilot Zeke Huelsbeck (above) who later crashed.

Light shield started life as aluminum screen, provides cool, directional light for animation.

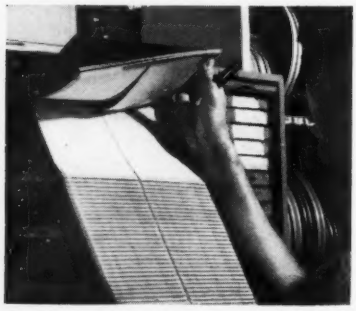


16mm enlargements are made on Beseler using double spool attachment to support reels.

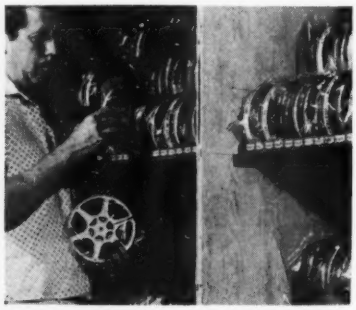


Movie photographers also do editing at McDonnell. Here, A and B rolls are being conformed.

GSAP (gun-sight) camera adapted for C-mount lenses, handles ground, aerial 16mm photography.



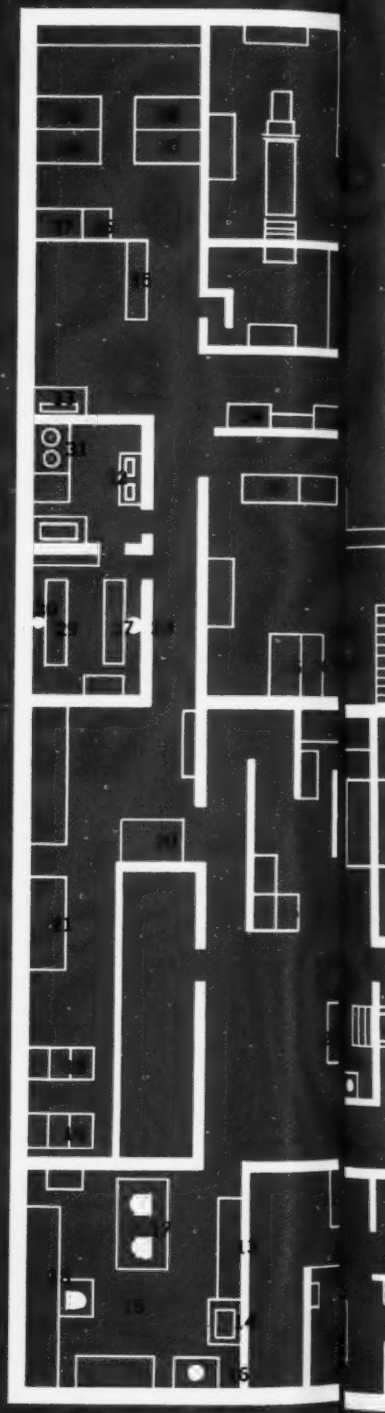
Cardex file provides complete data on all 16mm stock footage (over 750,000 ft.) in film file.

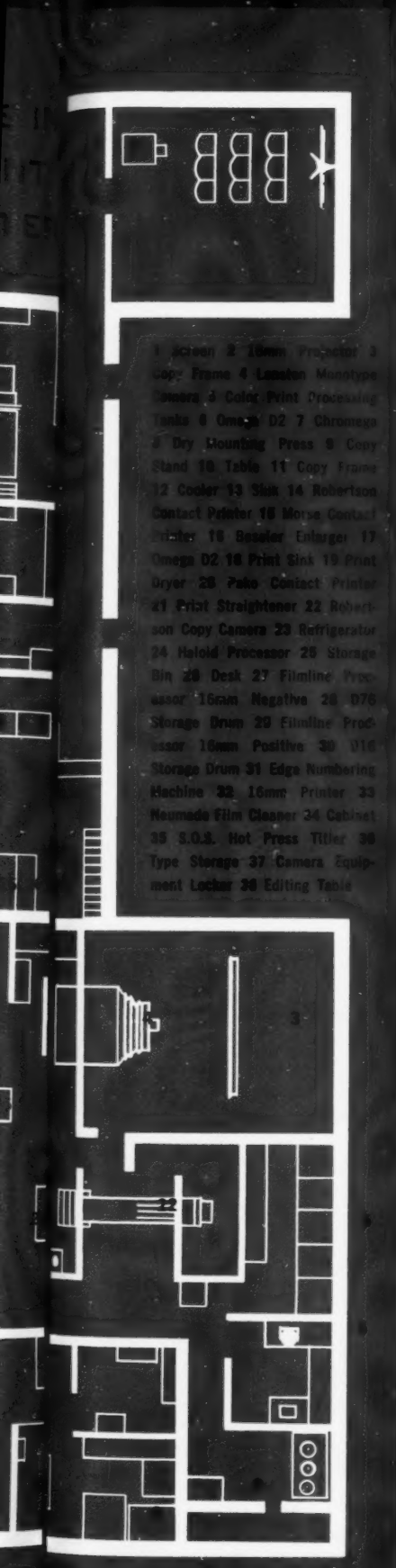


Stock footage is kept in 8 x 10 plastic bags, providing adequate, yet economical protection.

McDONNELL *(continued)*

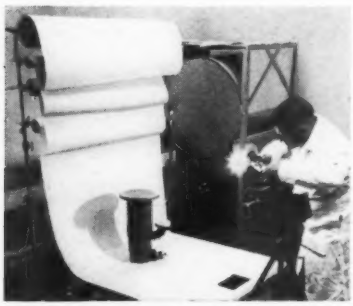
MAIN LAB IS I
A BASEMEI
BOMB SHELT



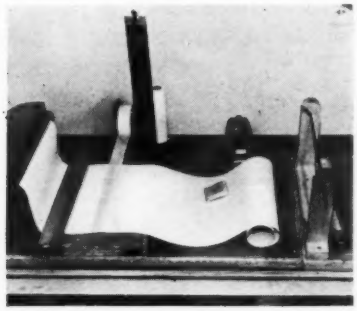


GIMMICKS AND GADGETS: STILL

Motor hoist was rigged up to lift color print baskets from one tank to another in processing.

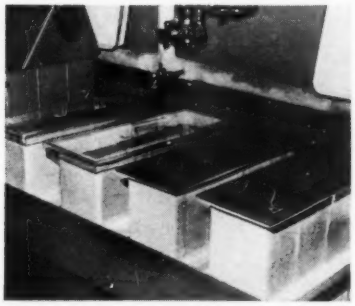


Pick a background from rolls of colored paper. Photographer can choose best color for subject.



Oscillograph leaders are spliced on paper before processing to insure getting complete trace.

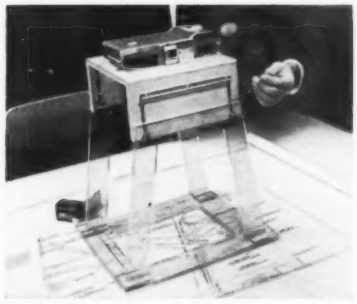
Extension button for timer helps operator avoid accidents, waste motion during enlarging.



Fiberglass color processing tanks, made by McDonnell at about 1/5 cost of commercial steel tanks.

Film data sheets are mounted on wall of film lab for easy reference. Some are revised revisions.

Crossbar is used to support mural paper during processing, allowing smooth, even handling.



Plexiglass copy stand is used by engineers for making quick Polaroid shots for handbook use.

This film took a year to complete, about 3000 man-hours being spent on its production. Released in April 1961, it has won an award for industrial films. It was photographed on Ektachrome Commercial, using the Mitchell on a Tel-Animation stand.

A geared ring was designed for the easel of the animation stand, giving the cameraman precise control over the subject cel without having to disturb the background cels. This device was used in *Man in Space* to simulate the pitch and roll of a missile against the celestial background.

In use, the background cels are placed on the easel of the animation stand. The subject cel goes into the geared ring, making possible 360-degree movement. There is, incidentally, a patent application on this device.

Aerial photography, although it is the most spectacular aspect of McDonnell movie production, is not always the most difficult. Interior shots and the lighting problems involved are often a greater problem. One reason is that the temperature in many test areas must be maintained within narrow temperature ranges. If the usual high-powered movie lights were used in these areas, the heat would raise the temperature beyond the permissible limit and, perhaps, nullify the test under observation.

Partly for this reason, interior shots are illuminated by R32 reflector floods in banks designed by the group. These banks consist of six or 12 R32 bulbs on a panel, all running into a single line. Plugging in the line will light all bulbs in the bank. An advantage of the photofloods is that no filter is necessary when using color film which is balanced for floods.

Exterior scenes are lighted with ColorTran units. These lights require an 81A filter when used with Ektachrome Commerical. (Unless movie footage is needed within a few hours, virtually all footage is shot in color. For black-and-white, Tri-X or Plus-X negative stock is used.)

Movie processing

McDonnell is one of the few in-plant sections which does its own black-and-white movie processing. Four Filmline processors are used, two at the main (34) lab, one at 42 lab and one at Edwards Air Force Base. One, at 34 lab, is used for positive processing; the other three are negative processors. Developers are D16 for positive and D76 for negatives. Reversal film is not processed nor do they print release prints. These jobs are handled by such outside labs as Colburn and Calvin. The labs also do the sound recording, selecting the desired type of music to go with the narration.

Writing is done by writers from field service while professional actors or announcers are used for narration.

Editing is done in the section. There are four editing positions at the lab, each with a B & H splicer and a Craig viewer.

In June of 1956, the Photo Department entered the color field, offering 11 x 14 Ektacolor prints (8 x 10's were available, but not ordered in any quantity). The first months in color represented a triumph of skill over technology, with McDonnell photographers operating without temperature control (they now use Powers valves) or nitrogen burst agitation or any of the fancy control gadgets considered basic to color processing.

Developers were kept at proper temperature by using buckets of ice cubes to cool developer. Eastman tech reps loaned tanks and provided samples of film and paper for the group to experiment with.

There was no capital budget for an expensive color processor so fiberglass tanks were made in the company workshops. Somewhat farsightedly, the tank was designed to hold 20 x 24 prints. At the time, this merely meant increased capacity for handling 11 x 14 but very soon, the photographic equivalent of Gresham's Law began to operate. This law states that "good large pictures will drive out good small pictures." At McDonnell, this meant a tremendous increase in requests for 20 x 24 and 11 x 14 color prints (8 x 10's were skipped completely in this affair).

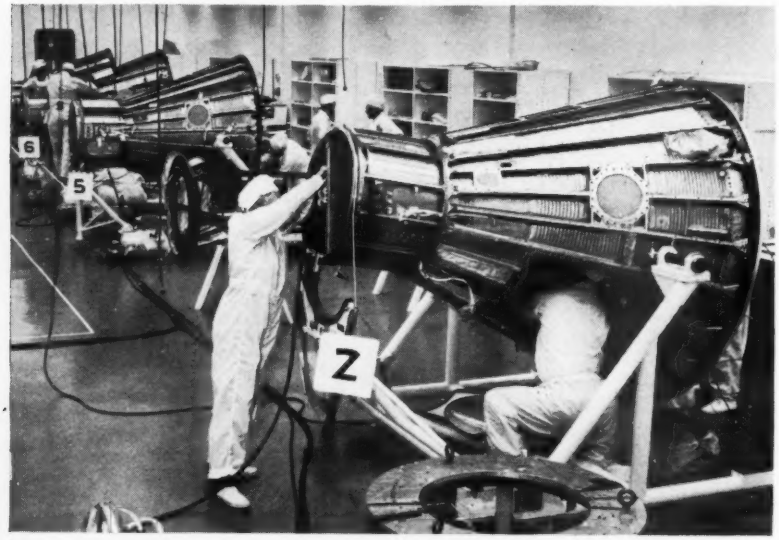
Present print capacity is 32 20 x 24 prints (or 64 11 x 14's) per batch. The first shift turns out about 4 batches, the second shift three to four, so that a maximum day's output is about 200 to 250 20 x 24 prints or 400 to 500 11 x 14 prints.

An Omega D2 and a Chromega are used in the color lab, each position with a Densichron. Every negative is read and the filter reading marked on the glassine sleeve. Any repeat orders can thus be made without reading the negative again.

In addition to the fiberglass tank, the color processing room contains a small hoist motor to lift the racks from one tray to another. This can be operated with one hand, leaving the other free to guide the tray.

Negative processing, mostly Ektacolor, Type S, is done according to Kodak recommendations with one change. Very often, exposure indexes of 100 to 150 are used. This requires an increase in

(continued on page 74)



Mercury space capsules being assembled in dust-free room at McDonnell.

THINKING WITH THUMBNAILS

MS: "Imagine a hypothetical film maker . . . without a knowledge of the ritual of film making. His first step in planning a motion picture: the drawing of pictures.

MCU: "It clarifies the picture's ideas for the client . . . who can't read, who is too busy to read, who prefers pictures to words, or who is too astute to trust words."

Imagine a hypothetical film maker, possessed of the necessary skills but without a knowledge of the ritual of film making. What would his first act be in the planning of a motion picture? I believe it would be the drawing of pictures. This, I feel, is the rational first step in planning a work that is primarily visual. (You can have a movie without sound but try to have one without pictures.)

I do not mean that my naive film maker would ignore sound. He would note the words, the musical and natural sounds which would go with his film. But first, in film, comes the picture, in this case, the story board.

A story board is the first stage in planning a film, representing the earliest visual ideas of a film maker. It may consist of a few stick figures on the back of an envelope. It may be a series of hundreds of drawings in which sequence, transition, color, action, all the values of the finished film, are indicated.

You may be familiar with several types of story boards. There is the story board where the pictures correspond, almost exactly, to the words. A writer says "this is a missile" and the picture shows a missile. This, however, is not an essential use of the story board. It is good if the script must be submitted to an authority who has not yet learned to read. Or, it may be that the word is superfluous, the idea being carried adequately by the picture without spelling it out.

Back to nature

Another type of story board tries to enliven a dull subject. During the war I came across an example in an Air Force training film. The story board artist used Mae West to arouse audience interest in whatever skill or technique the film was trying to promote. The actual subject had practically nothing to do with Miss West or her natural attributes. In this case, the picture merely served to carry an audience.

However, I feel that audience interest can be better captured by a familiarity with film techniques. Suspense and interest in a film must be built in, not dragged in. *(continued on page 82)*

RAW STOCK

Choice of a film stock . . .

. . . is no problem for most in-company men; they've already made up their minds

What kind of film does the 16mm industrial cameraman use?

According to PMI's informal survey, the answer is, most likely, color film, unless the footage is for some special purpose such as TV release, functional record shots, low-budget training films, etc.

The question isn't even a matter for debate: if it is worth making a movie, it is worth doing it in color. The color trade is shared by Eastman and Ansco.

Users seem divided as to the merit of the respective products. Ansco men cite the distinctive color rendition of Anscochrome and Super Anscochrome, their compatibility and good results in duplicating on the appropriate print stock.

Kodak users enjoy a wide variety of emulsions to choose from. Kodachrome is by and large too contrasty, where more than original camera footage will be shown, to be a serious contender for professional trade. Commercial Kodachrome, a lower-contrast emulsion, has been superseded. Kodachrome II is less contrasty because of certain dye characteristics (which make this a superb one-time film) but as yet, there is no satisfactory method of duplication. Eastman advises users to take Commercial Ektachrome whenever duplicate prints are needed, and most users go along. When used as a camera original film, it tends to be a bit flat for viewing purposes. However, it is just right for duplication purposes.

For more speed, there is Ektachrome ER, fastest of the color reversal materials. It can be intercut with Ektachrome Commercial but since it is a contrastier film, some users report that they must employ flatter lighting on ER when intercutting is planned. Eastman Color Negative is available only to 35mm users who seem overjoyed with this colored-coupler emlusion.

Black-and-white is by no means dead. TV and various functional applications have given them quite a shot in the arm. Kodak, Ansco and DuPont are all in there pitching. Here, the arguments are between users of reversal and negative raw stock.

Photographic characteristics of reversal and negative films are practically identical according to the manufacturers, although they are tailored differently along other lines for their respective processing methods.

Reversal men indicate that in general, reversal processing seems more consistent. Kodak states, "In comparison with the negative-positive method which requires two precisely-controlled processing systems and a printer, the reversal process needs little equipment and, once established, can be kept in control provided the customary attention is paid to agitation, times, temperatures and bath composition. This control is possible because of the broad latitude in most of the processing steps."

The fact that a positive image is delivered sans judgment and that dupes have this automatically-controlled positive as a quality benchmark may have some bearing on the situation.

Reversal men are very satisfied with the quality of present day films and the best of the processing. They feel that, with care, a positive dupe can equal or exceed the original. (Quality is exceeded when timing smooths out original exposure variations.) Furthermore, dirt acquired during the editing ends up as a black spot on the screen and not as a white one, which stands out like a Canaveral rocket on a moonless night.

The negative - positive men point to the theoretical limitations, left out of the reversalist's argument, as being more than theoretical. They point out that actually, a reversal film dupe has gone through at least four photographic generations: original exposure, reversal exposure, original and back to reversal again. The negative-positive process goes through only half as many.

They also point out that there is a greater choice of negative stocks than reversal stocks. Available in reversal in Plus-X, DuPont Rapid Reversal 930, Tri-X and High Speed Rapid Reversal 931.

In the negative-positive field, the choices include Ansco Super Hypan, the DuPont Superior series, Plus-X and Tri-X negative versions, the new Double-X film, Background Pan and various specialized recording films. There are, of course, assorted entries from foreign countries.

Where super-duper sensitivity is required or where special contrast is needed, it is much easier to push the working speed of the negative film or to change their contrast characteristics by varying the development.

But motion pictures are usually regarded as too serious a business for experimentation. Special speed and contrast characteristics are important only in newsreel work and in functional films where only the information is required, not picture quality. Little taste and, therefore, little argument, is involved. Producers of vast numbers of release prints tend toward negative-positive while those who have a smaller distribution tilt the balance toward the reversal side.

Actually, the processor has as important an influence in this area as the in-company crew. If he does a better job with one kind of film than another, the film which gives the better results is likely to be the choice of his customers.

What every young photographer should know about MOTION PICTURE LENSES

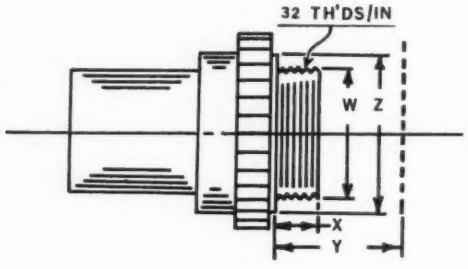
In some ways the designer of a motion picture lens has an easier job of it than the man who computes a still lens. There are two reasons for this, and both have to do with the format of the motion picture. Movie film is generally smaller than still film, and everything connected with a movie is scaled down, including lens focal lengths. This is a piece of good luck for the movie lens man, because as a lens is scaled down in size, lens defects are proportionally reduced. There is another, even more important, difference. With the exception of the relatively new wide-screen techniques which are still largely limited to theatrical productions, the field angle of a motion picture lens is a good deal narrower than its counterpart in still photography.

This field angle business is something of a tradition in motion pictures, but it seems to be based on practicalities. For one thing, when a motion picture scene is reconstituted before an audience, the picture on the screen seems most normal when the camera lens used to make the picture has an angle of view of about 20 to 25 degrees. For another, crop-

Table 1. Some typical focal lengths for lenses most frequently supplied and used with cameras using the standard film sizes noted. The wide-angle lenses usually cover about twice the field angle of the normal lens, while the "magnification" of the telephoto lenses is most often 2X or 3X, as shown in the table.

Film Size	Normal Focal Length	Wide-Angle	Tele-Photo
8MM	12.7MM	6.5MM	38MM
16MM	25 MM	12.7MM	75MM
35MM	50 MM	25 MM	150MM

CINE LENSES *(continued)*



Film Size and Mount Letter	8MM "D"	16MM "C"
Thread Diameter, Dimension "W"	.625 in.	1.000 in.
Lens Flange to Focus Dimension "Y"	.484	.690
Lens Flange Diameter Dimension "Z"	1.000	1.187
Thread Length Dimension "X"	.115	.160

Table 2. Some of the standard dimensions for the lens mounting thread and flange for 8mm and 16mm lenses. The data is taken from the ASA standard: PH22.76-1960 as revised from 1951. Tolerances recommended are for Screw Thread NS-2A.

Table 3. Some accuracies required for the typical expected central resolutions on fine-grained film for each of the main film sizes. Notice how the percent focus accuracy decreases even though the depth of focus increases for typical lenses in each of the three classes. The last row defines the accuracy of the squareness of optical axis and film plane.

Film Size	8MM	16MM	35MM
Expected resol'n lines per MM	70	60	50
Depth of focus at aperture f/2	.057MM	.067MM	.080MM
½ depth of focus in pct. of normal focal length lens	.45%	.27%	.16%
Film flatness req.	.028MM	.032MM	.040MM
Film squareness	.5 deg.	.21 deg.	.18 deg.

ping is impractical in motion pictures, and a longer lens helps the photographer fill the frame in more situations than does a short lens. Finally, in sound work, it is best to keep a certain distance between the camera and the subject to avoid picking up the camera noise with the microphone.

In any case, the normal field of view has come to be about half that of the "normal" still camera lens. This means that the focal length motion picture lens is approximately twice the diagonal dimension of the normal frame. Nowadays, high quality lenses are made in a variety of focal lengths for the movie camera but the so-called normal lens is still offered as the primary lens with the camera when purchased. *Table 1* lists the normal focal lengths for the various film formats, together with some typical wide angle and long focus or telephoto lenses which are frequently used.

The range of focal lengths and the usual narrower field angle of the motion picture lens aside, the designer has a difficult job cut out for himself when he makes lenses for the movies. He may have a head start, but so do his competitors. The optical requirements of his product are demanding in the extreme, and the mechanical requirements are indeed tough.

Today there is almost complete standardization of the thread mounting of movie camera lenses. The American Standards Association, in cooperation with the Society for Motion Picture and Television Engineers, has adopted a series of acceptable screw threads for lens mounting in each of the various film size cameras. *Table 2* is an excerpt from the standard for the 8 and 16mm camera lenses. (PH22.76-1960) One of the main departures from this standard arose out of the development of the 8mm camera lens turret. This resulted in a requirement for a lens thread and a lens-film distance, as measured from the lens flange, which differed for each manufacturer. While the dimensions were different in the various 8mm turret cameras, the tolerances and precision remained as tight as ever. In fact, as lens performance and film quality have improved in recent years, the precision requirement has had to keep up. *Table 3* lists some of the mechanical accuracy requirements for the familiar film format cameras, for the lens focal length based upon what is expected in sharpness or resolution at best. It must be remembered that the tolerance in focus, as expressed in *Table 3*, must be distributed among several mechanical parts of the camera and lens. Because of the increasing accuracy required today, most of the better lenses are provided with a factory adjustment, which, if desired, can be used to correct the lenses mechanically to bring them into sharpest infinity focus. Whenever a series of lenses are purchased to be used in a single camera, it is particularly useful to have the lenses adjusted so that they are most accurately focused when used in the camera. Since this requires highly precise test equipment, it is best done by either the lens or the camera manufacturer. There are a few independent camera repair services with the equipment to make this kind of matching. They should be called upon

if the factory services are not available.

While the mechanical parts of the movie camera lens require a high order of precision and, often, matching, the optical parts have their own stringent requirements which make them, in some ways, more critical than some of the still-camera lenses. Sharpness, color correction, and high transmission requirements are very strict. If we recall that what we see on the screen is the result of a series of processes: reprinting and projection, we realize that the quality of the taking lens, as well as the intermediate steps to producing of the projected image, must in each case be very high. For example, if the taking negative shows, after development, a resolving power of 50 lines per mm (high contrast), and the reduction printer optics show a resolving power of 60 lines per mm, then the output (print) can be expected to have around 28 lines per mm resolving power. (In mathematical language final resolution is the reciprocal of the sum of the reciprocals of the resolution each step; 1/R equals 1/A plus 1/B . . . 1/N.) Can you imagine the end result of several steps involving this kind of loss of sharpness, or resolution? It must be pointed out here, however, that apparent sharpness involves characteristics of the optics and image that may not be directly related to resolving power, so that the formula stated before may not yield a complete idea of the results. In general, the optical quality of the camera lens must be very high, represented by a resolving power figure of 60 to 80 lines per millimeter or better. In most of the better lenses, at openings one or two stops down from maximum, the lens itself may show imaging characteristics which exceed this performance level. When combined with good, fine grain film, the result should fall within the value given.

Among the first basic designs to find wide use in movie camera lenses was the Petzval lens. As shown in the first part of *Fig. 1*, this lens employs a pair of cemented or combined achromats with their off-axis aberrations balanced out. This design can be made quite fast, some of the popular-priced 8 and 16mm movie lenses of the Petzval type going up to f/1.4. The main problem with this design is that the best focal surface is curved. Not much can be done about the field curvature without allowing a little of the off-axis aberrations to return. Yet, because of the narrow coverage used in the regular cameras, a flat focal field can be obtained without severe loss of definition at the edges. The lens derives its name from the famous nineteenth century optical scientist, Petzval. With demand for a wider angular coverage and a greater variety of focal lengths, designs have been drawn from the Biotar type, and, in the case of the shortest focal length, from the inverted telephoto types. Again, the relatively narrower angular coverage has enabled cine-lens designers to trade off field for speed and higher sharpness, resolution and color correction. These two types of designs are shown in the center and right hand diagrams in *Fig. 1*.

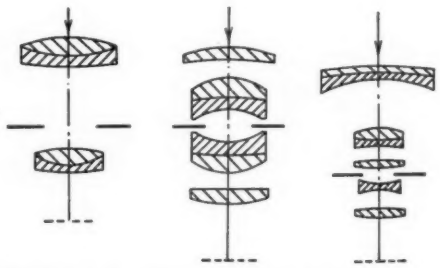


Fig. 1. Three typical designs for lenses used in movie cameras. On the left is the basic Petzval design, while the center diagram shows the Biotar type. These are used for the normal focal lengths. The right hand diagram shows a typical inverted telephoto design often used for the wide-angle lenses. In these diagrams, the film is shown as a line at the bottom.

One of the most serious problems for the cine-lens designer is the requirement for good and very uniform light transmission. When lenses are to be changed during the shooting of a scene, or single loading of the camera, small changes in the light transmission or "whiteness" of the lens glass are very troublesome. The most serious offenders in this case are the flint glasses. Since the dense flints find use in controlling zonal spherical aberration, this in turn being a problem in the very fast lenses, the development of clear white flint glasses in recent years have enabled the designers to get better clarity and less discoloration and shift of color balance in the fast lenses. Although lens coating does not, usually, contribute much to this troublesome shift of color balance, when there are many glass-air surfaces, particularly flint glass, coatings may add up to a quarter stop error or more. For this reason, as well as others, the movie camera user should try to test the lenses he purchases under the most critical conditions, preferably with pastel colors in the subject, to determine if, and how much, color balance shift is present. Careful selection of lenses can result in the desired matched set. Matching of the clarity, focal length and flange focal distance are some of the main characteristics which help to produce a valuable and useful set of lenses for a camera.

While the f/number of a lens defines the exposure obtained in the camera, other things being equal, it is a geometric quantity. That is to say, the f/number is determined from the dimensions of the lens. Yet, as any professional cameraman can report, two f/2 lenses may not show the same exposure. They may, in fact, differ by as much as half a stop. Most of this trouble evolves from the actual light transmission of the glass elements themselves. We discussed the effect of discoloration of the flint components but here we are referring to the overall transmission of the lens. If a particular f/stop is geometric, it is also based upon a lens with 100 per cent transmission. Now, if we measure the intrinsic transmission of the lens, that is, without regard to its image forming capa-

Table 4. Effect on f-number for various lens transmission values. The transmission measurement should account for the portions of the subject light spectrum for which the film is most sensitive. For example: Panchromatic film and daylight means that the blue transmission of the lens is the most important value. The table also shows some typical T-stops which result from correcting the nominal f-number for the transmission.

Lens Transmission	stop factor	stop loss	nominal f-number 1.4	2.0	2.8
90%	1.05	1/8	1.48	2.11	2.94
85	1.08		1.52	2.17	3.04
80	1.12	1/4	1.56	2.24	3.12
75	1.15	1/3	1.62	2.31	3.24
70	1.20		1.68	2.40	3.36
65	1.24	1/2	1.74	2.48	3.48
60	1.29	2/3	1.80	2.58	3.61
55	1.35		1.89	2.70	3.78
50	1.41	1	2.0	2.8	4.0

Check list for movie camera lenses

1. Inspect threads and flange for burrs or worn spots. **2.** Check and adjust for sharp infinity focus. **3.** Check and readjust for nearby subject distance —sharp focus if this is to be used frequently **4.** Check for satisfactory squareness of lens in mount by examining corners of negative shot of resolution targets on a flat wall as some intermediate distance. Be sure to get camera centered and square to central target. All corner targets should photograph about the same sharpness. **5.** Check for coloration of lens by making spectral transmission measurement. If not possible, coloration can be judged by looking at a large piece of flat white paper or blotter paper through lens and comparing this to the whiteness of the paper as seen just past the lens. Illuminate the paper with a bright tungsten lamp or daylight, but do not let the lens cast a shadow on the paper when it is held up in position. **6.** Measure effective transmission of lens for white light if color film is to be used, or blue light if panchromatic negative film is used. Look up stop-factor in Table 4 corresponding to measured transmission. T-stops for each nominal f-number marked on lens diaphragm ring are then obtained by multiplying the f-number by the stop-factor. Expected fractional stop-loss and some typical T stops are given in the same table. **7.** The same procedures should be followed for all of the lenses to be used in the camera, particularly the T-stop and discoloration tests if color film is to be used frequently.

bilities, we get some transmission less than 100 per cent. If the transmission is, say, around 87 per cent, this actually represents a loss of exposure amounting to the equivalent of a one-third stop, or say, from f/2.0 to f/2.2. Lower transmissions mean still larger losses in f/number. *Table 4* shows the f/number progression for a few transmission values and three typical nominal f/numbers. If the corrected f/number is determined by a transmission measurement, or by a critical exposure test, the resultant is called the "T-stop." Careful calibration of a lens for its "T-stop" values, corresponding to the marked f/numbers, is a valuable technique for the critical user.

The Zoom lens has enjoyed a resurgence of interest starting with the T.V. and 16mm movie zoom lenses of Dr. Back and the Zoomar Corp. of Glen Cove, N.Y., in the late 1940's. In general, modern zoom lenses are divided into two types: the mechanical zoom, and the optical zoom. In the former, changes in focus are corrected by a mechanical cam which shifts the rear element of the zoom section. Although the mechanical type can show wear after some use, when properly adjusted it does maintain exact focus throughout the zoom range. In the latter case, the optical design is such that the front and rear moving lenses of the zoom section can move together. Even so, the optical zoom has very slight errors of focus at some intermediate positions.

When a zoom lens is chosen for movie making in the great majority of cases, the lens is used at its shortest focal length position and then zoomed to the longest, closing in to concentrate the viewer's attention on the subject. If the zoom transition from short to long focal length is smooth, without severe intermediate late loss of sharpness, the results are very acceptable. Thus, its wise, when selecting a zoom lens, to check the short and long focal length position for maximum sharpness. If there are any intermediate positions which may be slightly unsharp, these may be noted, but it need not be a reason for rejecting the lens altogether. In general, check the mechanical zoom lens a little more carefully, remembering that adjustments can be made.

A few words in closing. While we have not mentioned them specificially, the wide-angle and telephoto lenses used in movie taking are quite similar in design to those used in the precision 35mm still cameras. The main difference is again, the field coverage, and as a result, the expected better sharpness over the film format used. In the case of the telephoto lens, it is not generally as important to calibrate the lens for transmission or exact color balance, however, focusing becomes a critical item. In some of the very long lenses, the environmental temperature requires a new set of calibrations for accurate focus. Often the lens manufacturer will supply a table of temperature adjustments with each lens.

The exacting task of producing a well exposed, uniformly balanced color movie "take" calls for a careful matching, calibrating and adjusting of the set of lenses to be used. The results are always worth the extra effort.—BENNETT SHERMAN

OFFICIAL DEPTH-OF-FIELD TABLES

FOR 35MM CAMERAS • FROM 21MM TO 1000MM

For the first time PHOTO METHODS FOR INDUSTRY presents a completely matched and integrated set of tables for your general and critical photographic work.

WHY YOU NEED THESE TABLES

The variety of depth-of-field tables engraved on lenses and on cameras, published by lens and camera manufacturers and appearing in countless guides and data sheets vary greatly in consistency and reliability. Many are hopelessly imprecise. Different formulas and standards are often applied to lenses of like focal length. We decided that a complete, comprehensive set of depth-of-field tables was needed for 35mm photography, applying the same rigid standards to all focal lengths from 21 to 1000mm. Actually, two sets of tables were necessary: one for the photographer who seldom makes a print larger than 11 x 14, or who projects his color transparencies only in his living room, and the other for the man whose pictures may stand mural-size enlargements or whose color shots may appear full-page in a finely printed magazine. Because of space limitations only the most popular focal lengths and apertures have been listed. However, an exhaustive depth-of-field table compilation of 29 focal lengths with 23 apertures at 14 different distant settings will shortly be available in book form. If you're interested, write in care of this publication.

HOW THEY WERE COMPUTED

Sharpness depends not only on the physical sharpness of the image itself but on the distance from which you view it as well. Up till now the "proper" viewing distance has been determined by multiplying the focal length of the camera lens used to take the picture (in inches) by the number of times the full negative is enlarged in printing or projection. For example: if you take a picture with a 50mm (2-in.) focal-length lens and enlarge the negative 10 times to fill a full 10 x 14-in. print, the "proper" distance for viewing and for determining picture sharpness would be 2 x 10 or 20 in.—about an arm's length in front of you. But who holds a print at arm's length? Isn't 12 in. a much more realistic viewing distance? However, the closer you come, the less sharp the picture becomes. And here's another point. If, instead of making a full negative enlargement, you blow up a small section of the 35mm format only to an 8 x 10 print, and you apply the so-called viewing rule of focal-length times magnification, you may end up viewing the print from 5 ft. away. Obviously, people rarely view a picture from the "proper" distance. A newer, more useful guide is needed. By tightening up the depth-of-field tables to give us a sharper image at a close viewing distance we could accomplish just this. Here's how we did it.

Subjects are actually made up of tiny points of light varying in tone. The lens transmits these points and deposits them on film. In theory, when the lens is focused on a specific subject plane, all points of the subject on that plane should be correspondingly sharp on the film. Out-of-focus points in front of and behind this plane gradually become blobs of light rather than points. If these blobs are too small to be distinguished from the perfectly sharp points, the blobs are considered to be within the zone of sharpness (depth of field). Once the blobs are large enough to be distinguished, they are considered unsharp or out of the zone. But at what point scientifically can the blobs be said to be too large? Lens and camera manufacturers use the so-called "proper" viewing distance, which gives an allowable blob on the negative of about 1/20 to 1/30mm. (This limit is called the "circle of confusion.") After much research and testing, as well as consultation with optical experts, we feel that blobs (circles of confusion) of 1/40mm and 1/50mm are more applicable to modern films and lenses and the closer viewing distance. The 1/40mm tables are sufficiently precise for general photographic work. For the most critical amateur and professional the 1/50mm circle is preferable.

How did we compute a full set of tables by using these circles of confusion? They were not computed by picking numbers out of a hat. Technical consultant Bennett Sherman supplied us with the following formulas. Computer Applications, Inc. in New York used an IBM 7090 electronic computer to make all the computations. Here's what was fed into the computer.

$$X_1 = A\left(1 + \frac{A}{B+K}\right)$$

$$X_2 = A\left(1 + \frac{A}{B-K}\right)$$

$$B = \frac{A^2}{D-A}$$

$$K = EM$$

X_1 = Near distance

X_2 = Far distance

B = Nominal lens focus distance beyond infinity focus point

K = ½ depth of focus

A = Lens focal length

D = Nominal subject distance from lens

E = f-number

M = Circle of confusion

HOW TO USE THEM

To use the Official Depth-of-Field tables, first locate the page with the focal length of your lens. Then, using either the general table for average photographic work or the critical for more precise work, locate your aperture and camera-to-subject distance. The table will give you the nearest and farthest distances between which a subject can be considered adequately sharp.

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.6"	2'10.4"	4' 7.6"	6' 3.5"	8' 7.3"	12' 0.7"	15' 1"	27' 6.1"	60'11.9"
	FAR	1' 6.4"	3' 1.8"	5' 5.2"	7'10.7"	11'11.2"	19'10.2"	29' 8.3"	276'10.5"	∞
f/1.2	NEAR	1' 5.5"	2'10"	4' 6.5"	6' 1.6"	8' 3.7"	11' 5.6"	14' 2.1"	24' 7.2"	48' 3.6"
	FAR	1' 6.5"	3' 2.3"	5' 6.7"	8' 2"	12' 6.9"	21' 8.3"	34' 0.5"	∞	∞
f/1.4	NEAR	1' 5.4"	2' 9.7"	4' 5.7"	6' 0.1"	8' 0.9"	11' 0.5"	13' 6.2"	22' 8.2"	41' 4.9"
	FAR	1' 6.6"	3' 2.7"	5' 8"	8' 4.8"	13' 1.7"	23' 5.3"	38' 6.7"	∞	∞
f/1.5	NEAR	1' 5.4"	2' 9.5"	4' 5.3"	5'11.3"	7'11.6"	10'10"	13' 2.5"	21'10"	38' 7.8"
	FAR	1' 6.7"	3' 2.9"	5' 8.7"	8' 6.2"	13' 5.3"	24' 5.1"	41' 3.6"	∞	∞
f/1.8	NEAR	1' 5.3"	2' 9"	4' 4.1"	5' 9.3"	7' 7.9"	10' 3.2"	12' 4.5"	19' 7.5"	32' 2.7"
	FAR	1' 6.8"	3' 3.5"	5'10.7"	8'10.9"	14' 5.3"	27'11.3"	52' 6.1"	∞	∞
f/1.9	NEAR	1' 5.2"	2' 8.9"	4' 3.8"	5' 8.6"	7' 6.7"	10' 1.1"	12' 1.4"	18'11.9"	30' 6.3"
	FAR	1' 6.8"	3' 3.7"	5'11.4"	9' 0.5"	14' 9.7"	29' 4.3"	57' 8.8"	∞	∞
f/2	NEAR	1' 5.2"	2' 8.8"	4' 3.4"	5' 7.9"	7' 5.6"	9'11"	11'10.5"	18' 4.7"	29' 0.1"
	FAR	1' 6.9"	3' 3.9"	6' 0.2"	9' 2.2"	15' 2.3"	30'11"	64' 1.3"	∞	∞
f/2.8	NEAR	1' 4.9"	2' 7.6"	4' 0.6"	5' 3.1"	6' 9.3"	8' 8.9"	10' 2.6"	14' 8.2"	20' 8.9"
	FAR	1' 7.3"	3' 5.8"	6' 6.5"	10' 6"	19' 2.2"	53'10.2"	558' 1.7"	∞	∞
f/4	NEAR	1' 4.4"	2' 6.1"	3' 9"	4' 9.1"	5'11.5"	7' 5"	8' 5.4"	11' 3.4"	14' 6.4"
	FAR	1' 7.9"	3' 8.9"	7' 6.6"	13' 4.5"	31' 8.8"	∞	∞	∞	∞
f/5.6	NEAR	1' 3.9"	2' 4.2"	3' 4.9"	4' 2.6"	5' 1.6"	6' 2.1"	6'10.5"	8' 7.6"	10' 4.8"
	FAR	1' 8.7"	4' 1.9"	9' 6"	21' 1.5"	254' 4.8"	∞	∞	∞	∞
f/8	NEAR	1' 3.2"	2' 1.9"	3'	3' 7.3"	4' 3.1"	4'11.3"	5' 4.5"	6' 4.7"	7' 3.6"
	FAR	1'10.2"	4'11.9"	15' 6.7"	166' 2.6"	∞	∞	∞	∞	∞
f/11	NEAR	1' 2.3"	1'11.4"	2' 7.4"	3' 0.7"	3' 6.1"	3'11.5"	4' 2.8"	4' 9.9"	5' 4"
	FAR	2' 0.4"	6' 8.2"	78' 7.7"	∞	∞	∞	∞	∞	∞
f/16	NEAR	1' 1.1"	1' 8.3"	2' 1.9"	2' 5.3"	2' 8.6"	2'11.8"	3' 1.6"	3' 5.3"	3' 8.2"
	FAR	2' 5.2"	15' 5.8"	∞	∞	∞	∞	∞	∞	∞
f/22	NEAR	0'11.9"	1' 5.5"	1' 9.4"	1'11.7"	2' 1.8"	2' 3.7"	2' 4.7"	2' 6.8"	2' 8.4"
	FAR	3' 2.5"	∞	∞	∞	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.7"	2'10.7"	4' 8.4"	6' 5.1"	8'10.3"	12' 6.6"	15'10.4"	30' 2.7"	76' 2.6"
	FAR	1' 6.3"	3' 1.4"	5' 4.1"	7' 8.3"	11' 5.9"	18' 7.7"	27' 0.8"	145' 1.1"	∞
f/1.2	NEAR	1' 5.6"	2'10.4"	4' 7.5"	6' 3.4"	8' 7.1"	12' 0.4"	15' 0.6"	27' 4.6"	60' 4.3"
	FAR	1' 6.4"	3' 1.8"	5' 5.3"	7'10.8"	11'11.5"	19'11"	29'10.1"	290' 9.4"	∞
f/1.4	NEAR	1' 5.5"	2'10.1"	4' 6.8"	6' 2.2"	8' 4.8"	11' 7.8"	14' 5.4"	25' 5.6"	51' 8.9"
	FAR	1' 6.5"	3' 2.1"	5' 6.2"	8' 0.9"	12' 4.4"	21' 0.8"	32' 6.2"	1481' 0.9"	∞
f/1.5	NEAR	1' 5.5"	2'10"	4' 6.5"	6' 1.6"	8' 3.7"	11' 5.6"	14' 2.1"	24' 7.2"	48' 3.6"
	FAR	1' 6.5"	3' 2.3"	5' 6.7"	8' 2"	12' 6.9"	21' 8.3"	34' 0.5"	∞	∞
f/1.8	NEAR	1' 5.4"	2' 9.6"	4' 5.5"	5'11.8"	8' 0.4"	10'11.5"	13' 4.7"	22' 4"	40' 3.1"
	FAR	1' 6.6"	3' 2.7"	5' 8.3"	8' 5.4"	13' 3.1"	23' 9.9"	39' 7.3"	∞	∞
f/1.9	NEAR	1' 5.4"	2' 9.5"	4' 5.2"	5'11.2"	7'11.3"	10' 9.5"	13' 1.8"	21' 8.1"	38' 1.7"
	FAR	1' 6.7"	3' 2.9"	5' 8.8"	8' 6.5"	13' 6.1"	24' 7.6"	41'10.7"	∞	∞
f/2	NEAR	1' 5.3"	2' 9.3"	4' 4.9"	5'10.6"	7'10.3"	10' 7.6"	12'11"	21' 0.5"	36' 2.9"
	FAR	1' 6.7"	3' 3.1"	5' 9.3"	8' 7.7"	13' 9.1"	25' 6"	44' 5.5"	∞	∞
f/2.8	NEAR	1' 5.1"	2' 8.4"	4' 2.5"	5' 6.4"	7' 2.9"	9' 6.4"	11' 3.8"	17' 1.1"	25'10.9"
	FAR	1' 7"	3' 4.5"	6' 2"	9' 6.5"	16' 2.4"	35' 5.3"	87' 3.2"	∞	∞
f/4	NEAR	1' 4.7"	2' 7.1"	3'11.3"	5' 1"	6' 5.8"	8' 3"	9' 6.6"	13' 4.1"	18' 1.9"
	FAR	1' 7.5"	3' 6.8"	6'10.2"	11' 3.7"	22' 1.1"	85' 8.1"	∞	∞	∞
f/5.6	NEAR	1' 4.3"	2' 5.5"	3' 7.7"	4' 7"	5' 8.2"	6'11.9"	7'10.9"	10' 4"	12'11.8"
	FAR	1' 8.1"	3'10.3"	8' 0.5"	15' 0.4"	43' 0.2"	∞	∞	∞	∞
f/8	NEAR	1' 3.6"	2' 3.4"	3' 3.1"	3'11.9"	4' 9.6"	5' 8.4"	6' 3.5"	7' 8.7"	9' 1.3"
	FAR	1' 9.2"	4' 4.8"	10'11"	29' 9.3"	∞	∞	∞	∞	∞
f/11	NEAR	1' 2.9"	2' 1.1"	2'10.6"	3' 5.3"	4' 0.3"	4' 7.6"	5' 0.2"	5'10.6"	6' 7.7"
	FAR	1'10.8"	5' 4.2"	19' 9.3"	∞	∞	∞	∞	∞	∞
f/16	NEAR	1' 1.9"	1'10.2"	2' 5.1"	2' 9.7"	3' 2.1"	3' 6.5"	3' 9.1"	4' 2.6"	4' 7.1"
	FAR	2' 1.9"	8' 4.7"	∞	∞	∞	∞	∞	∞	∞
f/22	NEAR	1' 0.8"	1' 7.4"	2' 0.5"	2' 3.6"	2' 6.5"	2' 9.2"	2'10.7"	3' 1.8"	3' 4.3"
	FAR	2' 7.2"	26'11.3"	∞	∞	∞	∞	∞	∞	∞

24MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.7"	2'10.7"	4' 8.6"	6' 5.4"	8'10.8"	12' 7.7"	16' 0.1"	30' 9.1"	79' 7.8"
	FAR	1' 6.3"	3' 1.3"	5' 3.9"	7' 7.9"	11' 5"	18' 5.3"	26' 7.8"	134' 0.7"	∞
f/1.2	NEAR	1' 5.6"	2'10.4"	4' 7.7"	6' 3.8"	8' 7.8"	12' 1.7"	15' 2.6"	27'11.1"	63' 0.9"
	FAR	1' 6.4"	3' 1.7"	5' 5"	7'10.3"	11'10.3"	19' 7.6"	29' 2.6"	240' 8"	∞
f/1.4	NEAR	1' 5.6"	2'10.2"	4' 7.1"	6' 2.6"	8' 5.5"	11' 9.2"	14' 7.6"	26' 0.2"	54' 0.9"
	FAR	1' 6.5"	3' 2"	5' 5.9"	8' 0.2"	12' 2.8"	20' 8.4"	31' 7.8"	662' 0.2"	∞
f/1.5	NEAR	1' 5.5"	2'10.1"	4' 6.7"	6' 2"	8' 4.4"	11' 7.1"	14' 4.3"	25' 1.9"	50' 5.7"
	FAR	1' 6.5"	3' 2.1"	5' 6.4"	8' 1.2"	12' 5.2"	21' 3.3"	33' 0.3"	5325' 0.1"	∞
f/1.8	NEAR	1' 5.4"	2' 9.7"	4' 5.8"	6' 0.3"	8' 1.2"	11' 1.1"	13' 7.1"	22'10.6"	42' 0.9"
	FAR	1' 6.6"	3' 2.6"	5' 7.8"	8' 4.4"	13' 0.8"	23' 2.7"	37'11.7"	∞	∞
f/1.9	NEAR	1' 5.4"	2' 9.6"	4' 5.5"	5'11.7"	8' 0.2"	10'11.2"	13' 4.2"	22' 2.6"	39'10.4"
	FAR	1' 6.6"	3' 2.8"	5' 8.3"	8' 5.5"	13' 3.6"	23'11.5"	39'11.8"	∞	∞
f/2	NEAR	1' 5.4"	2' 9.5"	4' 5.2"	5'11.2"	7'11.2"	10' 9.3"	13' 1.5"	21' 7.1"	37'10.5"
	FAR	1' 6.7"	3' 2.9"	5' 8.8"	8' 6.6"	13' 6.4"	24' 8.8"	42' 2.4"	∞	∞
f/2.8	NEAR	1' 5.1"	2' 8.6"	4' 2.9"	5' 7.1"	7' 4"	9' 8.3"	11' 6.5"	17' 7.2"	27' 0.9"
	FAR	1' 6.9"	3' 4.2"	6' 1.2"	9' 4.7"	15' 9.2"	33' 5.3"	76' 1.1"	∞	∞
f/4	NEAR	1' 4.8"	2' 7.3"	3'11.8"	5' 1.7"	6' 7"	8' 5"	9' 9.3"	13' 9.4"	18'11.7"
	FAR	1' 7.4"	3' 6.4"	6' 8.8"	11'	20'11.6"	70'11.9"	∞	∞	∞
f/5.6	NEAR	1' 4.4"	2' 5.8"	3' 8.2"	4' 7.9"	5' 9.6"	7' 2"	8' 1.5"	10' 8.4"	13' 6.9"
	FAR	1' 8"	3' 9.7"	7' 9.9"	14' 3.5"	37' 6.2"	∞	∞	∞	∞
f/8	NEAR	1' 3.8"	2' 3.7"	3' 3.8"	4' 0.9"	4'11"	5'10.4"	6' 5.9"	8' 0.3"	9' 6.3"
	FAR	1' 9"	4' 3.7"	10' 4.2"	25'11.7"	∞	∞	∞	∞	∞
f/11	NEAR	1' 3.1"	2' 1.5"	2'11.4"	3' 6.3"	4' 1.7"	4' 9.4"	5' 2.3"	6' 1.4"	6'11.4"
	FAR	1'10.4"	5' 1.9"	17' 5"	∞	∞	∞	∞	∞	∞
f/16	NEAR	1' 2.1"	1'10.6"	2' 5.9"	2'10.6"	3' 3.3"	3' 8"	3'10.8"	4' 4.7"	4' 9.6"
	FAR	2' 1.3"	7' 8.7"	∞	∞	∞	∞	∞	∞	∞
f/22	NEAR	1' 1"	1' 7.9"	2' 1.2"	2' 4.5"	2' 7.6"	2'10.5"	3' 0.1"	3' 3.5"	3' 6.2"
	FAR	2' 6"	19' 6.3"	∞	∞	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.8"	2'11"	4' 9.2"	6' 6.6"	9' 1.2"	13' 0.6"	16' 8.1"	33' 3.8"	99' 6.5"
	FAR	1' 6.2"	3' 1"	5' 3.1"	7' 6.2"	11' 1.2"	17' 7.6"	24'11.9"	100' 3.7"	∞
f/1.2	NEAR	1' 5.7"	2'10.7"	4' 8.5"	6' 5.3"	8'10.7"	12' 7.5"	15'11.7"	30' 7.6"	78' 9.8"
	FAR	1' 6.3"	3' 1.3"	5' 3.9"	7' 8"	11' 5.2"	18' 5.9"	26' 9"	136' 5.7"	∞
f/1.4	NEAR	1' 5.6"	2'10.5"	4' 8"	6' 4.3"	8' 8.7"	12' 3.6"	15' 5.5"	28' 9.3"	67' 6.8"
	FAR	1' 6.4"	3' 1.6"	5' 4.6"	7' 9.5"	11' 8.5"	19' 2.8"	28' 4.1"	191'10.1"	∞
f/1.5	NEAR	1' 5.6"	2'10.4"	4' 7.7"	6' 3.8"	8' 7.8"	12' 1.7"	15' 2.6"	27'11.1"	63' 0.9"
	FAR	1' 6.4"	3' 1.7"	5' 5"	7'10.3"	11'10.3"	19' 7.6"	29' 2.6"	240' 8"	∞
f/1.8	NEAR	1' 5.5"	2'10.1"	4' 6.9"	6' 2.3"	8' 5.1"	11' 8.4"	14' 6.2"	25' 8"	52' 6.9"
	FAR	1' 6.5"	3' 2"	5' 6.1"	8' 0.6"	12' 3.7"	20'11.1"	32' 2.2"	1018'10.6"	∞
f/1.9	NEAR	1' 5.5"	2'10"	4' 6.7"	6' 1.9"	8' 4.2"	11' 6.7"	14' 3.6"	24'11.9"	49' 9.7"
	FAR	1' 6.5"	3' 2.2"	5' 6.5"	8' 1.4"	12' 5.7"	21' 4.8"	33' 3.8"	∞	∞
f/2	NEAR	1' 5.5"	2' 9.9"	4' 6.4"	6' 1.4"	8' 3.3"	11' 5"	14' 1.1"	24' 4.2"	47' 3.9"
	FAR	1' 6.5"	3' 2.3"	5' 6.9"	8' 2.3"	12' 7.6"	21'10.7"	34' 6.3"	∞	∞
f/2.8	NEAR	1' 5.3"	2' 9.2"	4' 4.5"	5' 9.9"	7' 9"	10' 5.1"	12' 7.3"	20' 2.6"	33' 9.9"
	FAR	1' 6.7"	3' 3.3"	5'10.1"	8' 9.5"	14' 1.6"	26' 9.9"	48' 8.5"	∞	∞
f/4	NEAR	1' 5"	2' 8.1"	4' 1.8"	5' 5.2"	7' 0.8"	9' 2.7"	10'10.6"	16' 1.4"	23' 8.4"
	FAR	1' 7.1"	3' 4.9"	6' 3.5"	9'10.5"	17' 2.2"	40' 7.1"	127' 2.8"	∞	∞
f/5.6	NEAR	1' 4.7"	2' 6.8"	3'10.7"	4'11.8"	6' 3.9"	8'	9' 2.6"	12' 8.3"	16'11.4"
	FAR	1' 7.6"	3' 7.3"	7' 0.3"	11' 9.8"	24' 1.9"	129' 1"	∞	∞	∞
f/8	NEAR	1' 4.2"	2' 5"	3' 6.6"	4' 5.3"	5' 5.6"	6' 8.1"	7' 5.9"	9' 7.6"	11'10.7"
	FAR	1' 8.3"	3'11.5"	8' 6.2"	16' 9.7"	62' 1"	∞	∞	∞	∞
f/11	NEAR	1' 3.6"	2' 3.1"	3' 2.5"	3'10.9"	4' 8.2"	5' 6.4"	6' 1"	7' 4.9"	8' 8"
	FAR	1' 9.4"	4' 6"	11' 7.2"	35' 8.9"	∞	∞	∞	∞	∞
f/16	NEAR	1' 2.7"	2' 0.4"	2' 9.2"	3' 3.2"	3' 9.4"	4' 3.7"	4' 7.6"	5' 4.3"	5'11.8"
	FAR	1'11.4"	5'10.3"	29' 7.3"	∞	∞	∞	∞	∞	∞
f/22	NEAR	1' 1.8"	1' 9.8"	2' 4.5"	2' 8.8"	3' 0.9"	3' 5"	3' 7.3"	4' 0.4"	4' 4.5"
	FAR	2' 2.4"	9' 2.4"	∞	∞	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	nf
f/0.95	NEAR	1' 5.8"	2'11.1"	4' 9.4"	6' 7"	9' 2"	13' 2.4"	16'10.9"	34' 3.1"	108' 4.7"
	FAR	1' 6.2"	3' 0.9"	5' 2.8"	7' 5.7"	11'	17' 4.6"	24' 5.8"	92' 7.9"	∞
f/1.2	NEAR	1' 5.7"	2'10.8"	4' 8.8"	6' 5.8"	8'11.7"	12' 9.5"	16" 3"	31' 7.7"	85'10"
	FAR	1' 6.3"	3' 1.2"	5' 3.6"	7' 7.3"	11' 3.5"	18' 1.7"	26' 0.2"	119' 6.2"	∞
f/1.4	NEAR	1' 5.7"	2'10.7"	4' 8.3"	6' 4.9"	8' 9.9"	12' 5.8"	15' 9.1"	29' 9.8"	73' 7"
	FAR	1' 6.3"	3' 1.4"	5' 4.2"	7' 8.6"	11' 6.5"	18' 9.5"	27' 4.8"	155' 7.4"	∞
f/1.5	NEAR	1' 5.7"	2'10.6"	4' 8.1"	6' 4.4"	8' 9"	12' 4.1"	15' 6.3"	28'11.8"	68' 8.2"
	FAR	1' 6.3"	3' 1.5"	5' 4.5"	7' 9.3"	11' 8.1"	19' 1.7"	28' 1.7"	183' 3.8"	∞
f/1.8	NEAR	1' 5.6"	2'10.3"	4' 7.3"	6' 3.1"	8' 6.4"	11'11"	14'10.3"	26' 8.8"	57' 3"
	FAR	1' 6.4"	3' 1.9"	5' 5.5"	7'11.4"	12' 0.9"	20' 3.1"	30' 7.7"	393' 6"	∞
f/1.9	NEAR	1' 5.6"	2'10.2"	4' 7.1"	6' 2.6"	8' 5.6"	11' 9.4"	14' 7.8"	26' 0.8"	54' 2.9"
	FAR	1' 6.4"	3' 2"	5' 5.9"	8' 0.1"	12' 2.6"	20' 8"	31' 6.9"	637' 0.5"	∞
f/2	NEAR	1' 5.5"	2'10.1"	4' 6.9"	6' 2.2"	8' 4.8"	11' 7.8"	14' 5.3"	25' 5.1"	51' 6.4"
	FAR	1' 6.5"	3'2.1"	5' 6.2"	8' 0.9"	12' 4.4"	21' 1"	32' 6.8"	1672' 2.7"	∞
f/2,8	NEAR	1' 5.4"	2' 9.4"	4' 5.1"	5'10.9"	7'10.7"	10' 8.4"	13' 0.1"	21' 3.1"	36'10"
	FAR	1' 6.7"	3' 3"	5' 9.1"	8' 7.2"	13' 7.9"	25' 2.1"	43' 6.5"	∞	∞
f/4	NEAR	1' 5.1"	2' 8.4"	4' 2.6"	5' 6.5"	7' 2.9"	9' 6.4"	11' 3.8"	17' 0.8"	25' 9.8"
	FAR	1' 7"	3' 4.4"	6' 1.9"	9' 6.5"	16' 2.5"	35' 6.6"	88' 2.1"	∞	∞
f/5.6	NEAR	1' 4.8"	2' 7.2"	3'11.6"	5' 1.4"	6' 6.3"	8' 3.9"	9' 7.8"	13' 6.3"	18' 5.6"
	FAR	1' 7.4"	3' 6.5"	6' 9.5"	11' 2"	21' 7.2"	79' 1.8"	∞	∞	∞
f/8	NEAR	1' 4.3"	2' 5.6"	3' 7.7"	4' 7"	5' 8.3"	7'	7'10.9"	10' 3.8"	12'11.4"
	FAR	1' 8.1"	3'10.2"	8' 0.3"	15' 0.3"	43' 3"	∞	∞	∞	∞
f/11	NEAR	1' 3.8"	2' 3.7"	3' 3.7"	4' 0.8"	4'10.8"	5'10.1"	6' 5.5"	7'11.6"	9' 5.3"
	FAR	1' 9"	4' 3.7"	10' 5"	26' 6.4"	∞	∞	∞	∞	∞
f/16	NEAR	1' 3"	2' 1.1"	2'10.5"	3' 5.1"	3'11.9"	4' 7"	4'11.4"	5' 9.5"	6' 6.3"
	FAR	1'10.7"	5' 4.8"	20' 9.9"	∞	∞	∞	∞	∞	∞
f/22	NEAR	1' 2.1"	1'10.6"	2' 5.8"	2'10.6"	3' 3.2"	3' 7.8"	3'10.5"	4' 4.4"	4' 9.2"
	FAR	2' 1.3"	7' 9.3"	∞	∞	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.8"	2'11.3"	4' 9.9"	6' 8"	9' 3.9"	13' 6.3"	17' 5.4"	36' 6.7"	135' 5.6"
	FAR	1' 6.2"	3' 0.7"	5' 2.2"	7' 4.5"	10' 9.4"	16'10.1"	23' 5.2"	79' 1.7"	∞
f/1.2	NEAR	1' 5.8"	2'11.1"	4' 9.4"	6' 7"	9' 1.9"	13' 2.2"	16'10.6"	34' 1.7"	107' 3.2"
	FAR	1' 6.2"	3' 1"	5' 2.8"	7' 5.7"	11' 0.1"	17' 4.9"	24' 6.5"	93' 5.9"	∞
f/1.4	NEAR	1' 5.7"	2'10.9	4' 9"	6' 6.2"	9' 0.4"	12'11"	16' 5.4"	32' 5.2"	91'11.5"
	FAR	1' 6.3"	3' 1.1"	5' 3.3"	7' 6.8"	11' 2.4"	17'10.7"	25' 6.1"	109' 4.4"	∞
f/1.5	NEAR	1' 5.7"	2'10.8"	4' 8.8"	6' 5.8"	8'11.7"	12' 9.5"	16' 3"	31' 7.7"	85'10"
	FAR	1' 6.3"	3' 1.2"	5' 3.6"	7' 7.3"	11' 3.5"	18' 1.7"	26' 0.2"	119' 6.2"	∞
f/1.8	NEAR	1' 5.7"	2'10.6"	4' 8.2"	6' 4.7"	8' 9.5"	12' 5.1"	15' 7.9"	29' 5.7"	71' 6.5"
	FAR	1' 6.3"	3' 1.5"	5' 4.3"	7' 8.9"	11' 7.1"	18'11.2"	27' 8.3"	165' 7.6"	∞
f/1.9	NEAR	1' 5.6"	2'10.5"	4' 8"	6' 4.3"	8' 8.8"	12' 3.7"	15' 5.7"	28' 9.8"	67' 9.4"
	FAR	1' 6.4"	3' 1.5"	5' 4.6"	7' 9.4"	11' 8.4"	19' 2.5"	28' 3.5"	190' 1"	∞
f/2	NEAR	1' 5.6"	2'10.5"	4' 7.8"	6' 4"	8' 8.1"	12' 2.3"	15' 3.5"	28' 2.3"	64' 4.8"
	FAR	1' 6.4"	3' 1.6"	5' 4.9"	7'10"	11' 9.7"	19' 6"	28'11.1"	223' 0.2"	∞
f/2.8	NEAR	1' 5.5"	2' 9.9"	4' 6.3"	6' 1.2"	8' 2.9"	11' 4.2"	13'11.8"	24' 0.1"	46' 0.3"
	FAR	1' 6.5"	3' 2.3"	5' 7"	8' 2.7"	12' 8.7"	22' 2"	35' 2.8"	∞	∞
f/4	NEAR	1' 5.3	2' 9.1"	4' 4.2"	5' 9.3"	7' 8"	10' 3.3"	12' 4.6"	19' 7.8"	32' 2.9"
	FAR	1' 6.8"	3' 3.5"	5'10.6"	8'10.7"	14' 5"	27'10.7"	52' 4.4"	∞	∞
f/5.6	NEAR	1' 5"	2' 8.1"	4' 1.6"	5' 4.8"	7' 0.2"	9' 1.6"	10' 9.1"	15' 9.8"	23' 0.7"
	FAR	1' 7.1"	3' 5"	6' 4"	9'11.7"	17' 6.2"	42' 7"	149' 7.4"	∞	∞
f/8	NEAR	1' 4.6"	2' 6.6"	3'10.2"	4'11.1"	6' 2.7"	7' 9.9"	8'11.8"	12' 3"	16' 2"
	FAR	1' 7.6"	3' 7.7"	7' 1.9"	12' 2.5"	25'11"	205' 3.5"	∞	∞	∞
f/11	NEAR	1' 4.2"	2' 5"	3' 6.6"	4' 5.2"	5' 5.5"	6' 7.7"	7' 5.5"	9' 6.8"	11' 9.4"
	FAR	1' 8.3"	3'11.5"	8' 6.6"	16'11.8"	65' 0.5"	∞	∞	∞	∞
f/16	NEAR	1' 3.5"	2' 2.7"	3' 1.7"	3' 9.7"	4' 6.4"	5' 3.8"	5' 9.8"	7' 0.2"	8' 1.6"
	FAR	1' 9.6"	4' 7.7"	12' 8.4"	49' 3.6"	∞	∞	∞	∞	∞
f/22	NEAR	1' 2.7"	2' 0.4"	2' 9.1"	3' 3.1"	3' 9.2"	4' 3.5"	4' 7.3"	5' 3.9"	5'11.3"
	FAR	1'11.3"	5'10.5"	30' 8.3"	∞	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.4"	4'10.4"	6' 8.8"	9' 5.5"	13' 9.6"	17'10.9"	38' 7.7"	169' 4"
	FAR	1' 6.1"	3' 0.6"	5' 1.7"	7' 3.5"	10' 7.4"	16' 5.2"	22' 7.8"	70'10.2"	∞
f/1.2	NEAR	1' 5.8"	2'11.3"	4' 9.9"	6' 8"	9' 3.8"	13' 6.1"	17' 5.2"	36' 5.6"	134' 1"
	FAR	1' 6.2"	3' 0.7"	5' 2.2"	7' 4.5"	10' 9.5"	16'10.3"	23' 5.6"	79' 7.2"	∞
f/1.4	NEAR	1' 5.8"	2'11.1"	4' 9,6"	6' 7.3"	9' 2.6"	13' 3.5"	17' 0.8"	34'10.7"	114'11.3"
	FAR	1' 6.2"	3' 0.9"	5' 2.6"	7' 5.3"	10'11.2"	17' 2.6"	24' 2"	88' 3.8"	∞
f/1.5	NEAR	1' 5.8"	2'11.1"	4' 9.4"	6' 7"	9' 2"	13' 2.2"	16'10.7"	34' 1.9"	107' 3.5"
	FAR	1' 6.2"	3' 0.9"	5' 2.8"	7' 5.7"	11' 0.1"	17' 4.8"	24' 6.4"	93' 5.3"	∞
f/1.8	NEAR	1' 5.7"	2'10.9"	4' 9"	6' 6.1"	9' 0.2"	12'10.5"	16' 4.5"	32' 1.5"	89' 5.1"
	FAR	1' 6.3"	3' 1.1"	5' 3.4"	7' 6.9"	11' 2.8"	17'11.7"	25' 8.3"	113' 1.4"	∞
f/1.9	NEAR	1' 5.7"	2'10.8"	4' 8.8"	6' 5.8"	8'11.6"	12' 9.3"	16' 2.6"	31' 6"	84' 8.7"
	FAR	1' 6.3"	3' 1.2"	5' 3.6"	7' 7.3"	11' 3.7"	18' 2.1"	26' 1.3"	121' 7.9"	∞
f/2	NEAR	1' 5.7"	2'10.8"	4' 8.6"	6' 5.5"	8'11"	12' 8.1"	16' 0.7"	30'10.8"	80' 5.9"
	FAR	1' 6.3"	3' 1.3"	5' 3.8"	7' 7.8"	11' 4.6"	18' 4.6"	26' 6.4"	131' 7.2"	∞
f/2.8	NEAR	1' 5.6"	2'10.3"	4' 7.4"	6' 3.2"	8' 6.6"	11'11.2"	14'10.6"	26' 9.7"	57' 6.4"
	FAR	1' 6.4"	3' 1.8"	5' 5.5"	7'11.3"	12' 0.7"	20' 2.5"	30' 6.4"	380' 6"	∞
f/4	NEAR	1' 5.4"	2' 9.7"	4' 5.6"	5'11.9"	8' 0.6"	10'11.7"	13' 5"	22' 4.5"	40' 3.7"
	FAR	1' 6.6"	3' 2.7"	5' 8.1"	8' 5.1"	13' 2.7"	23' 9.1"	39' 5.7"	∞	∞
f/5.6	NEAR	1' 5.2"	2' 8.8"	4' 3.5"	5' 8"	7' 5.6"	9'11"	11'10.4"	18' 4"	28' 9.9"
	FAR	1' 6.8"	3' 3.8"	6'	9' 2.1"	15' 2.3"	31' 0.4"	64' 9.9"	∞	∞
f/8	NEAR	1' 4.9"	2' 7.6"	4' 0.5"	5' 2.9"	6' 8.9"	8' 8"	10' 1.3"	14' 5.3"	20' 2.5"
	FAR	1' 7.2"	3' 5.8"	6' 6.8"	10' 7.1"	19' 6.8"	57' 6.3"	1903' 2.2"	∞	∞
f/11	NEAR	1' 4.6"	2' 6.3"	3' 9.3"	4' 9.5"	6' 0.1"	7' 5.9"	8' 6.5"	11' 5"	14' 8.8"
	FAR	1' 7.7"	3' 8.5"	7' 5.4"	13' 1.7"	30' 7.9"	∞	∞	∞	∞
f/16	NEAR	1' 4"	2' 4.3"	3' 4.8"	4' 2.4"	5' 1.2"	6' 1.4"	6' 9.5"	8' 5.7"	10' 1.9"
	FAR	1' 8.6"	4' 1.9"	9' 7.5"	22'	611' 8.4"	∞	∞	∞	∞
f/22	NEAR	1' 3.3"	2' 2.2"	3' 0.5"	3' 7.9"	4' 3.8"	5' 0.2"	5' 5.5"	6' 5.9	7' 5.1"
	FAR	1' 9.9"	4'10.5"	14'10.2"	119' 8.3"	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.5"	4'10.7"	6' 9.4"	9' 6.7"	14' 0.3"	18' 3.5"	40' 5.8"	211' 7.7"
	FAR	1' 6.1"	3' 0.5"	5' 1.4"	7' 2.8"	10' 5.8"	16' 1.5"	22' 0.8"	65' 4.7"	∞
f/1.2	NEAR	1' 5.9"	2'11.4"	4'10.3"	6' 8.8"	9' 5.4"	13' 9.4"	17'10.7"	38' 6.6"	167' 6.9"
	FAR	1' 6.1"	3' 0.6"	5' 1.8"	7' 3.6"	10' 7.4"	16' 5.4"	22' 8.2"	71' 2"	∞
f/1.4	NEAR	1' 5.8"	2'11.3"	4'10.1"	6' 8.2"	9' 4.4"	13' 7.2"	17' 7"	37' 1.6"	143' 7.8"
	FAR	1' 6.2"	3' 0.7"	5' 2.1"	7' 4.2"	10' 8.8"	16' 8.7"	23' 2.4"	76' 6.9"	∞
f/1.5	NEAR	1' 5.8"	2'11.3"	4' 9.9"	6' 8"	9' 3.8"	13' 6.1"	17' 5.2"	36' 5.6"	134' 1"
	FAR	1' 6.2"	3' 0.7"	5' 2.2"	7' 4.5"	10' 9.5"	16'10.3"	23' 5.6"	79' 7.2"	∞
f/1.8	NEAR	1' 5.8"	2'11.1"	4' 9.5"	6' 7.2"	9' 2.4"	13' 3"	16'11.9"	34' 7.1"	111' 9.1"
	FAR	1' 6.2"	3' 0.9"	5' 2.7"	7' 5.4"	10'11.5"	17' 3.5"	24' 3.7"	90' 3.6"	∞
f/1.9	NEAR	1' 5.8"	2'11.1"	4' 9.4"	6' 7"	9' 1.9"	13' 2"	16'10.2"	34' 0.1"	105'10.5"
	FAR	1' 6.2"	3' 1"	5' 2.8"	7' 5.8"	11' 0.2"	17' 5.3"	24' 7.3"	94' 6.4"	∞
f/2	NEAR	1' 5.8"	2'11"	4' 9.3"	6' 6.7"	9' 1.4"	13' 1"	16' 8.6"	33' 5.4"	100' 7.1"
	FAR	1' 6.2"	3' 1"	5' 3"	7' 6.1"	11' 0.9"	17' 7.1"	24'10.9"	99' 2.3"	∞
f/2.8	NEAR	1' 5.7"	2'10.6"	4' 8.3"	6' 4.8"	8' 9.6"	12' 5.3"	15' 8.2"	29' 6.5"	71'10.6"
	FAR	1' 6.3"	3' 1.4"	5' 4.3"	7' 8.8"	11' 6.9"	18'10.7"	27' 7.5"	163' 8.6"	∞
f/4	NEAR	1' 5.5"	2'10.1"	4' 6.8"	6' 2.1"	8' 4.5"	11' 7.2"	14' 4.3"	25' 1.7"	50' 4.2"
	FAR	1' 6.5"	3' 2.1"	5' 6.3"	8' 1.1"	12' 5.1"	21' 3.2"	33' 0.3"	7105'10.2"	∞
f/5.6	NEAR	1' 5.4"	2' 9.4"	4' 5"	5'10.7"	7'10.4"	10' 7.6"	12'10.9"	20'11.8"	36'
	FAR	1' 6.7"	3' 3"	5' 9.2"	8' 7.6"	13' 9.1"	25' 6.6"	44' 8.6"	∞	∞
f/8	NEAR	1' 5.1"	2' 8.4"	4' 2.5"	5' 6.2"	7' 2.5"	9' 5.5"	11' 2.6"	16' 9.9"	25' 2.8"
	FAR	1' 7"	3' 4.5"	6' 2.2"	9' 7.2"	16' 5"	36' 7.8"	95' 6.6"	∞	∞
f/11	NEAR	1' 4.8"	2' 7.3"	3'11.6"	5' 1.4"	6' 6.3"	8' 3.8"	9' 7.6"	13' 5.8"	18' 4.6"
	FAR	1' 7.4"	3' 6.5"	6' 9.4"	11' 2"	21' 7.9"	80' 5.9"	∞	∞	∞
f/16	NEAR	1' 4.3"	2' 5.5"	3' 7.6"	4' 6.8"	5' 7.8"	6'11.1"	7' 9.7"	10' 1.8"	12' 8.1"
	FAR	1' 8.1"	3'10.3"	8' 1.3"	15' 4.3"	46' 6.5"	∞	∞	∞	∞
f/22	NEAR	1' 3.8"	2' 3.7"	3' 3.6"	4' 0.5"	4'10.3"	5' 9.3"	6' 4.5"	7'10"	9' 3"
	FAR	1' 9"	4' 4"	10' 7.4"	28' 1.2"	∞	∞	∞	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.7"	4'11.2"	6'10.4"	9' 8.7"	14' 4.7"	18'11.1"	43' 8.6"	345' 6.2"
	FAR	1' 6.1"	3' 0.3"	5' 0.8"	7' 1.7"	10' 3.5"	15' 8"	21' 2.5"	58' 4.9"	∞
f/1.2	NEAR	1' 5.9"	2'11.6"	4'11"	6'10"	9' 7.9"	14' 2.8"	18' 7.9"	42' 3.8"	273' 6.8"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2.1"	10' 4.4"	15'10.2"	21' 6.6"	61' 1.3"	∞
f/1.4	NEAR	1' 5.9"	2'11.6"	4'10.8"	6' 9.7"	9' 7.2"	14' 1.4"	18' 5.4"	41' 3.1"	234' 6.1"
	FAR	1' 6.1"	3' 0.4"	5' 1.2"	7' 2.5"	10' 5.2"	16'	21'10"	63' 5.5"	∞
f/1.5	NEAR	1' 5.9"	2'11.5"	4'10.7"	6' 9.5"	9' 6.9"	14' 0.7"	18' 4.2"	40' 9"	218'10.6"
	FAR	1' 6.1"	3' 0.4"	5' 1.3"	7' 2.7"	10' 5.6"	16' 1"	21'11.7"	64' 8.5"	∞
f/1.8	NEAR	1' 5.9"	2'11.5"	4'10.5"	6' 9"	9' 6"	13'10.6"	18' 0.6"	39' 3.6"	182' 5.2"
	FAR	1' 6.1"	3' 0.5"	5' 1.6"	7' 3.2"	10' 6.7"	16' 3.8"	22' 5.1"	68' 9"	∞
f/1.9	NEAR	1' 5.9"	2'11.4"	4'10.4"	6' 8.9"	9' 5.6"	13' 9.9"	17'11.5"	38'10.1"	172'10.1"
	FAR	1' 6.1"	3' 0.6"	5' 1.7"	7' 3.4"	10' 7.1"	16' 4.7"	22' 6.9"	70' 2.6"	∞
f/2	NEAR	1' 5.9"	2'11.4"	4'10.3"	6' 8.7"	9' 5.3"	13' 9.2"	17'10.3"	38' 4.7"	164' 2.5"
	FAR	1' 6.1"	3' 0.6"	5' 1.8"	7' 3.6"	10' 7.5"	16' 5.7"	22' 8.7"	71' 9"	∞
f/2.8	NEAR	1' 5.8"	2'11.2"	4' 9.7"	6' 7.5"	9' 2.9"	13' 4"	17' 1.5"	35' 1.5"	117' 4"
	FAR	1' 6.2"	3' 0.8"	5' 2.5"	7' 5.1"	10'10.8"	17' 1.8"	24' 0.5"	86'10.6"	∞
f/4	NEAR	1' 5.7"	2'10.8"	4' 8.8"	6' 5.7"	8'11.4"	12' 8.7"	16' 1.6"	31' 2"	82' 2.2"
	FAR	1' 6.3"	3' 1.2"	5' 3.6"	7' 7.5"	11' 4.1"	18' 3.3"	26' 3.9"	127' 2"	∞
f/5.6	NEAR	1' 5.6"	2'10.4"	4' 7.6"	6' 3.4"	8' 7"	12'	14'11.8"	27' 1.1"	58' 9"
	FAR	1' 6.4"	3' 1.7"	5' 5.2"	7'10.9"	11'11.8"	20' 0.4"	30' 1.8"	333' 9.9"	∞
f/8	NEAR	1' 5.5"	2' 9.8"	4' 5.9"	6' 0.3"	8' 1.2"	11' 0.7"	13' 6.4"	22' 7.9"	41' 2.1"
	FAR	1' 6.5"	3' 2.5"	5' 7.8"	8' 4.4"	13' 1.2"	23' 4.9"	38' 7"	∞	∞
f/11	NEAR	1' 5.3"	2' 9"	4' 3.9"	5' 8.7"	7' 6.7"	10' 0.9"	12' 0.9"	18' 9.9"	29'11.9"
	FAR	1' 6.7"	3' 3.6"	5'11.2"	9' 0.4"	14'10.1"	29' 8.2"	59' 4.6"	∞	∞
f/16	NEAR	1' 5⁴'	2' 7.9"	4' 0.9"	5' 3.5"	6' 9.7"	8' 9.3"	10' 3"	14' 8.3"	20' 8"
	FAR	1' 7.1"	3' 5.4"	6' 5.9"	10' 5.1"	19' 0.8"	53' 9.9"	607'10.6"	∞	∞
f/22	NEAR	1' 4.7"	2' 6.6"	3' 9.8"	4'10.2"	6' 1.1"	7' 7.2"	8' 8.1"	11' 7.7"	15' 0.9"
	FAR	1' 7.6"	3' 8"	7' 3.8"	12' 9.5"	29' 0.7"	2875' 4.2"	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.8"	4'11.4"	6'10.7"	9' 9.4"	14' 6.1"	19' 1.5"	44'10.1"	431'10.2"
	FAR	1' 6"	3' 0.2"	5' 0.7"	7' 1.3"	10' 2.8"	15' 6.3"	20'11.5"	56' 6"	∞
f/1.2	NEAR	1' 5.9"	2'11.7"	4'11.2"	6'10.4"	9' 8.7"	14' 4.6"	18'10.9"	43' 7.9"	341'11"
	FAR	1' 6.1"	3' 0.3"	5' 0.8"	7' 1.7"	10' 3.5"	15' 8.1"	21' 2.7"	58' 6.1"	∞
f/1.4	NEAR	1' 5.9"	2'11.7"	4'11.1"	6'10.1"	9' 8.2"	14' 3.4"	18' 8.9"	42' 9.1"	293' 1.2"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2"	10' 4.1"	15' 9.5"	21' 5.3"	60' 2.6"	∞
f/1.5	NEAR	1' 5.9"	2'11.6"	4'11"	6'10"	9' 7.9"	14' 2.8"	18' 7.9"	42' 3.8"	273' 6.8"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2.1"	10' 4.4"	15'10.2"	21' 6.6"	61' 1.3"	∞
f/1.8	NEAR	1' 5.9"	2'11.6"	4'10.8"	6' 9.6"	9' 7.1"	14' 1.1"	18' 4.9"	41' 0.7"	228'
	FAR	1' 6.1"	3' 0.4"	5' 1.3"	7' 2.6"	10' 5.3"	16' 0.4"	21'10.7"	63'11.4"	∞
f/1.9	NEAR	1' 5.9"	2'11.5"	4'10.7"	6' 9.5"	9' 6.9"	14' 0.6"	18' 4"	40' 7.8"	216' 0.1"
	FAR	1' 6.1"	3' 0.4"	5' 1.3"	7' 2.7"	10' 5.6"	16' 1.1"	22' 0.1"	64'11.5"	∞
f/2	NEAR	1' 5.9"	2'11.5"	4'10.7"	6' 9.4"	9' 6.6"	14' 1.2"	18' 3"	40' 3.1"	205' 2.6"
	FAR	1' 6.1"	3' 0.5"	5' 1.4"	7' 2.8"	10' 5.9"	16' 1.9"	22' 1.5"	66"	∞
f/2.8	NEAR	1' 5.8"	2'11.3"	4'10.1"	6' 8.4"	9' 4.6"	13' 7.6"	17' 7.6"	37' 4.2"	146' 7.6"
	FAR	1' 6.1"	3' 0.7"	5' 2"	7' 4"	10' 8.5"	16' 8.1"	23' 1.3"	75' 8.4"	∞
f/4	NEAR	1' 5.8"	2'11.1"	4' 9.4"	6' 6.9"	9' 1.7"	13' 1.5"	16' 9.4"	33' 8.4"	102' 8.3"
	FAR	1' 6.2"	3' 1"	5' 2.9"	7' 5.9"	11' 0.5"	17' 6.1"	24' 9.1"	97' 1.6"	∞
f/5.6	NEAR	1' 5.7"	2'10.7"	4' 8.4"	6' 5"	8'10"	12' 6"	15' 9.3"	29' 9.8"	73' 4.8"
	FAR	1' 6.3"	3' 1.4"	5' 4.1"	7' 8.5"	11' 6.3"	18' 9.2"	27' 4.4"	156' 1.8"	∞
f/8	NEAR	1' 5.6"	2'10.2"	4' 7"	6' 2.4"	8' 5"	11' 8"	14' 5.6"	25' 5.2"	51' 5.1"
	FAR	1' 6.4"	3' 2"	5' 6"	8' 0.6"	12' 4"	21' 0.5"	32' 6.2"	1790' 3"	∞
f/11	NEAR	1' 5.4"	2' 9.6"	4' 5.3"	5'11.3"	7'11.4"	10' 9.3"	13' 1.3"	21' 5.9"	37' 5.4"
	FAR	1' 6.6"	3' 2.8"	5' 8.6"	8' 6.4"	13' 6.3"	24' 9.7"	42' 6.6"	∞	∞
f/16	NEAR	1' 5.2"	2' 8.6"	4' 2.8"	5' 6.7"	7' 3.3"	9' 6.7"	11' 4.2"	17' 1.1"	25' 9.5"
	FAR	1' 6.9"	3' 4.2"	6' 1.5"	9' 5.9"	16' 1.5"	35' 4.7"	87'10.7"	∞	∞
f/22	NEAR	1' 4.9"	2' 7.5"	4'	5' 2"	6' 7.2"	8' 5.1"	9' 9.3"	13' 8.8"	18' 9.7"
	FAR	1' 7.2"	3' 6.1"	6' 8.3"	10'11.5"	20'11.8"	72'10.1"	∞	∞	∞

55MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.8"	4'11.3"	6'10.7"	9' 9.3"	14' 5.9"	19' 1.2"	44' 8.3"	418' 0.7"
	FAR	1' 6"	3' 0.2"	5' 0.7"	7' 1.4"	10' 2.8"	15' 6.5"	20'11.8"	56' 8.9"	∞
f/1.2	NEAR	1' 5.9"	2'11.7"	4'11.2"	6'10.4"	9' 8.6"	14' 4.4"	18'10.6"	43' 5.8"	331'
	FAR	1' 6.1"	3' 0.3"	5' 0.9"	7' 1.7"	10' 3.6"	15' 8.3"	21' 3.2"	58'10"	∞
f/1.4	NEAR	1' 5.9"	2'11.7"	4'11"	6'10.1"	9' 8.1"	14' 3.2"	18' 8.5"	42' 6.7"	283' 8.9"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2"	10' 4.2"	15' 9.8"	21' 5.9"	60' 7.4"	∞
f/1.5	NEAR	1' 5.9"	2'11.6"	4'11"	6'10"	9' 7.8"	14' 2.6"	18' 7.4"	42' 1.3"	264'10"
	FAR	1' 6.1"	3' 0.3"	5' 1.1"	7' 2.2"	10' 4.5"	15'10.5"	21' 7.3"	61' 6.6"	∞
f/1.8	NEAR	1' 5.9"	2'11.6"	4'10.8"	6' 9.6"	9' 7"	14' 0.8"	18' 4.4"	40' 9.8"	220' 8.7"
	FAR	1' 6.1"	3' 0.4"	5' 1.3"	7' 2.6"	10' 5.5"	16' 0.8"	21'11.5"	64' 6.5"	∞
f/1.9	NEAR	1' 5.9"	2'11.5"	4'10.7"	6' 9.4"	9' 6.7"	14' 0.2"	18' 3.4"	40' 4.9"	209' 1.4"
	FAR	1' 6.1"	3' 0.4"	5' 1.4"	7' 2.8"	10' 5.8"	16' 1.6"	22' 0.9"	65' 7.2"	∞
f/2	NEAR	1' 5.9"	2'11.5"	4'10.6"	6' 9.3"	9' 6.4"	13'11.6"	18' 2.4"	40' 0.1"	198' 8.1"
	FAR	1' 6.1"	3' 0.5"	5' 1.4"	7' 2.9"	10' 6.1"	16' 2.3"	22' 2.4"	66' 8.3"	∞
f/2.8	NEAR	1' 5.8"	2'11.3"	4'10.1"	6' 8.3"	9' 4.4"	13' 7.2"	17' 6.8"	37' 0.6"	141'11.5"
	FAR	1' 6.1"	3' 0.7"	5' 2"	7' 4.2"	10' 8.8"	16' 8.8"	23' 2.7"	76'11.9"	∞
f/4	NEAR	1' 5.8	2'11.1"	4' 9.3"	6' 6.8"	9' 1.4"	13' 0.9"	16' 8.4"	33' 4.2"	99' 5.1"
	FAR	1' 6.2"	3' 1"	5' 3"	7' 6.1"	11' 0.9"	17' 7.2"	24'11.3"	100' 2.6"	∞
f/5.6	NEAR	1' 5.7"	2'10.7"	4' 8.3"	6' 4.8"	8' 9.7"	12' 5.3"	15' 8"	29' 5.3"	71' 0.8"
	FAR	1' 6.3"	3' 1.4"	5' 4.2"	7' 8.7"	11' 6.9"	18'11"	27' 8.3"	167' 9.6"	∞
f/8	NEAR	1' 5.6"	2'10.2"	4' 6.9"	6' 2.1"	8' 4.5"	11' 7.1"	14' 4.1"	25' 0.5"	49' 9.6"
	FAR	1' 6.4"	3' 2"	5' 6.2"	8' 1.1"	12' 5.1"	21' 3.7"	33' 2.2"	∞	∞
f/11	NEAR	1' 5.4"	2' 9.5"	4' 5.2"	5'11"	7'10.8"	10' 8.2"	12'11.7"	21' 1.3"	36' 3.2"
	FAR	1' 6.6"	3' 2.8"	5' 8.9"	8' 7.1"	13' 8"	25' 3.9"	44' 1.7"	∞	∞
f/16	NEAR	1' 5.2"	2' 8.5"	4' 2.6"	5' 6.4"	7' 2.6"	9' 5.5"	11' 2.4"	16' 8.9"	24'11.9"
	FAR	1' 6.9"	3' 4.3"	6' 1.9"	9' 7"	16' 5.2"	36'11.8"	98' 8.3"	∞	∞
f/22	NEAR	1' 4.9"	2' 7.4"	3'11.8"	5' 1.6"	6' 6.5"	8' 3.8"	9' 7.5"	13' 5.1"	18' 2.7"
	FAR	1' 7.2"	3' 6.2"	6' 9.1"	11' 1.8"	21' 8.7"	83' 1.2"	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 6"	2'11.8"	4'11.5"	6'11"	9' 9.8"	14' 7.1"	19' 3.3"	45' 7.9"	522' 6.3"
	FAR	1' 6"	3' 0.2"	5' 0.5"	7' 1.1"	10' 2.3"	15' 5.2"	20' 9.4"	55' 3"	∞
f/1.2	NEAR	1' 5.9"	2'11.8"	4'11.3"	6'10.7"	9' 9.3"	14' 5.8"	19' 1.1"	44' 7.7"	413' 8.4"
	FAR	1' 6"	3' 0.2"	5' 0.7"	7' 1.4"	10' 2.9"	15' 6.6"	21'	56' 9.9"	∞
f/1.4	NEAR	1' 5.9"	2'11.7"	4'11.2"	6'10.5"	9' 8.8"	14' 4.9"	18'11.4"	43'10.3"	354' 7.5"
	FAR	1' 6.1"	3' 0.3"	5' 0.8"	7' 1.6"	10' 3.4"	15' 7.8"	21' 2.1"	58' 1.8"	∞
f/1.5	NEAR	1' 5.9"	2'11.7"	4'11.2"	6'10.4"	9' 8.6"	14' 4.4"	18'10.6"	43' 5.8"	331'
	FAR	1' 6.1"	3' 0.3"	5' 0.9"	7' 1.7"	10' 3.6"	15' 8.3"	21' 3.2"	58'10"	∞
f/1.8	NEAR	1' 5.9"	2'11.6"	4'11"	6'10"	9' 7.9"	14' 2.9"	18' 8"	42' 4.5"	275'10.3"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2.1"	10' 4.4"	15'10.1"	21' 6.4"	60'11.9"	∞
f/1.9	NEAR	1' 5.9"	2'11.6"	4'11"	6' 9.9"	9' 7.7"	14' 2.5"	18' 7.2"	42' 0.2"	261' 4.2"
	FAR	1' 6.1"	3' 0.4"	5' 1.1"	7' 2.2"	10' 4.6"	15'10.7"	21' 7.5"	61' 8.9"	∞
f/2	NEAR	1' 5.9"	2'11.6"	4'10.9"	6' 9.8"	9' 7.5"	14' 2"	18' 6.4"	41' 8"	248' 3.5"
	FAR	1' 6.1"	3' 0.4"	5' 1.1"	7' 2.3"	10' 4.9"	15'11.3"	21' 8.6"	62' 6.2"	∞
f/2.8	NEAR	1' 5.9"	2'11.5"	4'10.5"	6' 9"	9' 5.8"	13'10.3"	18' 0.1"	39' 0.8"	177' 4.9"
	FAR	1' 6.1"	3' 0.5"	5' 1.6"	7' 3.3"	10' 6.9"	16' 4.2"	22' 5.9"	69' 5.8"	∞
f/4	NEAR	1' 5.8"	2'11.2"	4' 9.8"	6' 7.8"	9' 3.4"	13' 5"	17' 3.2"	35' 8.7"	124' 2.8"
	FAR	1' 6.2"	3' 0.8"	5' 2.3"	7' 4.8"	10'10.1"	17' 0.1"	23' 9.2"	83' 5.2"	∞
f/5.6	NEAR	1' 5.8"	2'10.9"	4' 9"	6' 6.2"	9' 0.2"	12'10.5"	16' 4.5"	32' 0.8"	88' 9.5"
	FAR	1' 6.2"	3' 1.1"	5' 3.3"	7' 6.8"	11' 2.7"	17'11.7"	25' 8.5"	113'11.8"	∞
f/8	NEAR	1' 5.7"	2'10.5"	4' 7.8"	6' 3.9"	8' 7.9"	12' 1.7"	15' 2.4"	27' 9.7"	62' 2.5"
	FAR	1' 6.3"	3' 1.6"	5' 4.9"	7'10.1"	11'10.2"	19' 7.8"	29' 3.7"	253' 3.5"	∞
f/11	NEAR	1' 5.5"	2'10"	4' 6.4"	6' 1.3"	8' 2.9"	11' 4"	13'11.4"	23'10.3"	45' 3.5"
	FAR	1' 6.5"	3' 2.2"	5' 6.9"	8' 2.6"	12' 8.8"	22' 3"	35' 6.4"	∞	∞
f/16	NEAR	1' 5.3"	2' 9.2"	4' 4.2"	5' 9.3"	7' 7.7"	10' 2.5"	12' 3.3"	19' 3.5"	31' 2.3"
	FAR	1' 6.7"	3' 3.4"	5'10.6"	8'11.1"	14' 6.6"	28' 6.7"	55' 1.1"	∞	∞
f/22	NEAR	1' 5.1"	2' 8.2"	4' 1.8"	5' 5"	7' 0.3"	9' 1.5"	10' 8.8"	15' 8.5"	22' 8.8"
	FAR	1' 7"	3' 4.8"	6' 3.7"	9'11.5"	17' 6.8"	43' 4.7"	163' 6.7"	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 5.9"	2'11.8"	4'11.4"	6'10.8"	9' 9.6"	14' 6.5"	19' 2.3"	45' 2.1"	464'10.7"
	FAR	1' 6"	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.5"	15' 5.9"	20'10.6"	55'11.8"	∞
f/1.2	NEAR	1' 5.9"	2'11.7"	4'11.3"	6'10.5"	9' 8.9"	14' 5.1"	18'11.9"	44' 0.7"	368' 1"
	FAR	1' 6"	3' 0.2"	5' 0.8"	7' 1.6"	10' 3.2"	15' 7.5"	21' 1.5"	57' 9.6"	∞
f/1.4	NEAR	1' 5.9"	2'11.7"	4'11.1"	6'10.3"	9' 8.4"	14' 4"	18' 9.9"	43' 2.5"	315' 6.3"
	FAR	1' 6.1"	3' 0.3"	5' 0.9"	7' 1.8"	10' 3.8"	15' 8.8"	21' 3.9"	59' 4.1"	∞
f/1.5	NEAR	1' 5.9"	2'11.7"	4'11.1"	6'10.2"	9' 8.2"	14' 3.5"	18' 9.0"	42' 9.5"	294' 6"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2"	10' 4.1"	15' 9.4"	21' 5.2"	60' 1.8"	∞
f/1.8	NEAR	1' 5.9"	2'11.6"	4'10.9"	6' 9.1"	9' 7.5"	14' 1.9"	18' 6.2"	41' 7.1"	245' 5.4"
	FAR	1' 6.1"	3' 0.4"	5' 1.2"	7' 2.4"	10' 4.9"	15'11.4"	21' 8.9"	62' 8.3"	∞
f/1.9	NEAR	1' 5.9"	2'11.6"	4'10.8"	6' 9.7"	9' 7.2"	14' 1.4"	18' 5.3"	41' 2.5"	232' 6.5"
	FAR	1' 6.1"	3' 0.4"	5' 1.2"	7' 2.5"	10' 5.2"	16' 0.1"	21'10.2"	63' 7.1"	∞
f/2	NEAR	1' 5.9"	2'11.6"	4'10.8"	6' 9.6"	9' 7"	14' 0.8"	18' 4.4"	40'10"	220'11.1"
	FAR	1' 6.1"	3' 0.4"	5' 1.3"	7' 2.6"	10' 5.5"	16' 0.8"	21'11.4"	64' 6.2"	∞
f/2.8	NEAR	1' 5.9"	2'11.4"	4'10.3"	6. 8.6"	9' 5.1"	13' 8.7"	17' 9.5"	38' 0.5"	157'10.3"
	FAR	1' 6.1"	3' 0.6"	5' 1.8"	7' 3.7"	10' 7.8"	16' 6.4"	22'10.2"	73'	∞
f/4	NEAR	1' 5.8"	2'11.1"	4' 9.6"	6' 7.3"	9' 2.4"	13' 3.0"	16'11.8"	34' 6.1"	110' 6.7"
	FAR	1' 6.2"	3' 0.9"	5' 2.6"	7' 5.4"	10'11.5"	17' 3.5"	24' 4"	90'11.6"	∞
f/5.6	NEAR	1' 5.7"	2'10.8"	4' 8.7"	6' 5.5"	8'11"	12' 7.9"	16' 0.3"	30' 8.6"	79' 0.3"
	FAR	1' 6.3"	3' 1.2"	5' 3.8"	7' 7.7"	11' 4.7"	18' 5.1"	26' 7.8"	135'5.8"	∞
f/8	NEAR	1' 5.6"	2'10.4"	4' 7.4"	6' 3"	8' 6.2"	11'10.4"	14' 9.2"	26' 4.4"	55' 4.5"
	FAR	1' 6.4"	3' 1.8"	5. 5.5"	7'11.5"	12' 1.4"	20' 5.2"	31' 1.1"	511' 8"	∞
f/11	NEAR	1' 5.5"	2' 9.8"	4' 5.8"	6' 0.2"	8' 0.9"	11' 0.1"	13' 5.4"	22' 5"	40' 3.9"
	FAR	1' 6.5"	3' 2.5"	5' 7.9"	8' 4.7"	13' 2.1"	23' 7.9"	39' 3.7"	∞	∞
f/16	NEAR	1' 5.3"	2' 8.9"	4' 3.4"	5' 7.8"	7' 5.1"	9' 9.9"	11' 8.7"	17'11.4"	27' 9.4"
	FAR	1' 6.8"	3' 3.8"	6' 0.2"	9' 2.8"	15' 4.9"	32' 1.9"	70' 5.1"	∞	∞
f/22	NEAR	1' 5"	2' 7.8"	4' 0.8"	5' 3.3"	6' 9.3"	8' 8.5"	10' 1.9"	14' 5.9"	20' 3.1"
	FAR	1' 7.1"	3' 5.5"	6' 6.2"	10' 6"	19' 4.6"	56' 8.6"	1546' 4.3"	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		18 in.	3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	Inf.
f/0.95	NEAR	1' 6"	2'11.8"	4'11.5"	6'11.1"	9'10"	14' 7.6"	19' 4.2"	46' 0.8"	581' 0.9"
	FAR	1' 6"	3' 0.1"	5' 0.5"	7' 1"	10' 2"	15' 4.6"	20' 8.4"	54' 8.1"	∞
f/1.2	NEAR	1' 5.9"	2'11.8"	4'11.4"	6'10.8"	9' 9.5"	14' 6.5"	19' 2.2"	45' 1.6"	460' 0.7"
	FAR	1' 6"	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.6"	15' 5.9"	20'10.7"	56' 0.6"	∞
f/1.4	NEAR	1' 5.9"	2'11.7"	4'11.3"	6'10.6"	9' 9.1"	14' 5.6"	19' 0.6"	44' 4.9"	394' 4.3"
	FAR	1' 6"	3' 0.2"	5' 0.7"	7' 1.5"	10' 3"	15' 6.9"	21' 0.6"	57' 2.5"	∞
f/1.5	NEAR	1' 5.9"	2'11.7"	4'11.3"	6'10.5"	9' 8.9"	14' 5.1"	18'11.9"	44' 0.7"	368' 1"
	FAR	1' 6"	3' 0.2"	5' 0.8"	7' 1.6"	10' 3.2"	15' 7.5"	21' 1.5"	57' 9.6"	∞
f/1.8	NEAR	1' 5.9"	2'11.7"	4'11.1"	6'10.2"	9' 8.4"	14' 3.8"	18' 9.6"	43' 0.5"	306' 9.2"
	FAR	1' 6.1"	3' 0.3"	5' 0.9"	7' 1.9"	10' 3.9"	15' 9"	21' 4.4"	59' 8"	∞
f/1.9	NEAR	1' 5.9"	2'11.7"	4'11.1"	6'10"	9' 8"	14' 3.4"	18' 8.8"	42' 8.5"	290' 7.6"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2"	10' 4.1"	15' 9.5"	21' 5.4"	60' 3.7"	∞
f/2	NEAR	1' 5.9"	2'11.6"	4'11"	6'10"	9' 8"	14' 2.9"	18' 8.1"	42' 4.6"	276' 1.3"
	FAR	1' 6.1"	3' 0.3"	5' 1"	7' 2.1"	10' 4.3"	15'10.1"	21' 6.4"	60'11.7"	∞
f/2.8	NEAR	1' 5.9"	2'11.5"	4'10.6"	6' 9.3"	9' 6.4"	13'11.6"	18' 2.3"	39'11.4"	197' 3.3"
	FAR	1' 6.1"	3' 0.5"	5' 1.4"	7' 2.9"	10' 6.2"	16' 2.4"	22' 2.6"	66'10.2"	∞
f/4	NEAR	1' 5.8"	2'11.3"	4'10.1"	6' 8.2"	9' 4.2"	13' 6.8"	17' 6.2"	36' 9.4"	138' 1.8"
	FAR	1' 6.1"	3' 0.7"	5' 2.1"	7' 4.3"	10' 9"	16' 9.4"	23' 3.9"	78' 1.7"	∞
f/5.6	NEAR	1' 5.8"	2'11.1"	4' 9.3"	6'6.7"	9' 1.3"	13' 0.8"	16' 8.2"	33' 3.3"	98' 8.8"
	FAR	1' 6.2"	3' 1"	5' 3"	7' 6.1"	11' 1"	17' 7.4"	24'11.8"	100'10.9"	∞
f/8	NEAR	1' 5.7"	2'10.7"	4' 8.2"	6' 4.7"	8' 9.3"	12' 4.6"	15' 7"	29' 1.4"	69' 2"
	FAR	1' 6.3"	3' 1.4"	5' 4.3"	7' 9"	11' 7.5"	19' 0.6"	27'11.8"	179' 5.1"	∞
f/11	NEAR	1' 5.6"	2'10.2"	4' 7"	6' 2.2"	8' 4.7"	11' 7.5"	14' 4.7"	25' 2.2"	50' 4.3"
	FAR	1' 6.4"	3' 2"	5' 6.1"	8' 0.9"	12' 4.6"	21' 2.4"	32'11.1"	6993' 5.9"	∞
f/16	NEAR	1' 5.4"	2' 9.4"	4' 4.9"	5'10.5"	7' 9.9"	10' 6.6"	12' 9.3"	20' 6.8"	34' 8.2"
	FAR	1' 6.6"	3' 3"	5' 9.4"	8' 8.1"	13'10.8"	26' 1.7"	46' 8.8"	∞	∞
f/22	NEAR	1' 5.2"	2' 8.6"	4' 2.7"	5' 6.6"	7' 2.9"	9' 6"	11' 3.1"	16'10.5"	25' 3.3"
	FAR	1' 6.9"	3' 4.2"	6' 1.7"	9' 6.5"	16' 3.6"	36' 4.2"	94' 4.9"	∞	∞

90MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.6"	6'11.3"	9'10.4"	14' 8.4"	19' 5.6"	46' 8.9"	87' 8.4"	708'11.5"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.7"	20' 6.8"	53' 9"	116' 3.9"	∞
f/1.8	NEAR	2'11.8"	4'11.6"	6'11.1"	9'10.1"	14' 7.7"	19' 4.4"	46' 1.7"	85' 7.2"	590'10.2"
	FAR	3' 0.1"	5' 0.5"	7' 0.9"	10' 1.9"	15' 4.5"	20' 8.2"	54' 6.8"	120' 3"	∞
f/1.9	NEAR	2'11.8"	4'11.5"	6'11.1"	9'10"	14' 7.5"	19' 4"	45'11.3"	84'11"	559' 9.2"
	FAR	3' 0.1"	5' 0.5"	7' 1"	10' 2.1"	15' 4.8"	20' 8.6"	54'10.2"	121' 7.5"	∞
f/2	NEAR	2'11.8"	4'11.5"	6'11"	9' 9.9"	14' 7.2"	19' 3.5"	45' 9"	84' 3"	531' 9.5"
	FAR	3' 0.2"	5' 0.5"	7' 1"	10' 2.2"	15' 5"	20' 9.1"	55' 1.5"	123' 0.3"	∞
f/2.8	NEAR	2'11.8"	4'11.3"	6'10.6"	9' 9.1"	14' 5.4"	19' 0.3"	44' 2.9"	79' 3.1"	379'11.2"
	FAR	3' 0.2"	5' 0.7"	7' 1.5"	10' 3.1"	15' 7.1"	21' 0.9"	57' 5.9"	135' 6.1"	∞
f/3.5	NEAR	2'11.7"	4'11.1"	6'10.3"	9' 8.4"	14' 3.9"	18' 9.6"	43' 0.1"	75' 4.3"	304' 0.1"
	FAR	3' 0.3"	5' 0.9"	7' 1.8"	10' 3.8"	15' 9"	21' 4.4"	59' 8.7"	148' 8.7"	∞
f/4	NEAR	2'11.7"	4'11"	6'10"	9' 7.9"	14' 2.7"	18' 7.7"	42' 2"	72' 9.6"	266' 0.5"
	FAR	3' 0.3"	5' 1"	7' 2.1"	10' 4.4"	15'10.3"	21' 6.9"	61' 5.2"	159'10.4"	∞
f/5.6	NEAR	2'11.5"	4'10.6"	6' 9.3"	9' 6.3"	13'11.3"	18' 1.8"	39' 8.2"	65' 8"	190' 1.4"
	FAR	3' 0.5"	5' 1.4"	7' 3"	10' 6.3"	16' 2.8"	22' 3.4"	67' 7.6"	210' 3.8"	∞
f/8	NEAR	2'11.3"	4'10.1"	6' 8.1"	9' 4.1"	13' 6.4"	17' 5.5"	36' 5.6"	57' 3.1"	133' 2"
	FAR	3' 0.7"	5' 2.1"	7' 4.3"	10' 9.2"	16'10"	23' 5.2"	79' 8.5"	399' 8.5"	∞
f/11	NEAR	2'11.1"	4' 9.4"	6' 6.8"	9' 1.4"	13' 0.7"	16' 8"	33' 1.4"	49' 4.4"	96'11.2"
	FAR	3' 0.9"	5' 2.9"	7' 6"	11' 1"	17' 7.7"	25' 0.6"	102' 7.7"	∞	∞
f/16	NEAR	2'10.7"	4' 8.3"	6' 4.6"	8' 9.2"	12' 4"	15' 5.9"	28' 8.7"	40' 2"	66' 8.8"
	FAR	3' 1.4"	5' 4.3"	7' 9.1"	11' 7.9"	19' 2.2"	28' 3.7"	197' 7.8"	∞	∞
f/22	NEAR	2'10.3"	4' 7"	6' 2.2"	8' 4.5"	11' 6.8"	14' 3.5"	24' 9.6"	32'10.1"	48' 7.4"
	FAR	3' 1.9"	5' 6.1"	8' 1"	12' 5.3"	21' 5.2"	33' 6.8"	∞	∞	∞
f/32	NEAR	2' 9.5"	4' 5"	5'10.5"	7' 9.7"	10' 5.9"	12' 8"	20' 2.5"	25' 2.5"	33' 6.2"
	FAR	3' 2.9"	5' 9.3"	8' 8.4"	14' 0.1"	26' 8.2"	48' 8.8"	∞	∞	∞
f/45	NEAR	2' 8.7"	4' 2.6"	5' 6.2"	7' 2.1"	9' 4.3"	11' 0.5"	16' 3.7"	19' 4.7"	23'11"
	FAR	3' 4.2"	6' 2"	9' 7.9"	16' 9.2"	39' 3"	119' 1.4"	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.7"	14' 9.1"	19' 6.9"	47' 4.3"	89'11"	886' 1.5"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.3"	15' 3"	20' 5.4"	52'11.5"	112' 7.7"	∞
f/1.8	NEAR	2'11.9"	4'11.6"	6'11.3"	9'10.5"	14' 8.6"	19' 5.9"	46'10.4"	88' 1.6"	738' 5.8"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.6"	20' 6.5"	53' 7.1"	115' 6.8"	∞
f/1.9	NEAR	2'11.9"	4'11.6"	6'11.3"	9'10.4"	14' 8.4"	19' 5.5"	46' 8.4"	87' 6.7"	699' 7.6"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.8"	20' 6.9"	53' 9.6"	116' 6.9"	∞
f/2	NEAR	2'11.9"	4'11.6"	6'11.2"	9'10.3"	14' 8.2"	19' 5.2"	46' 6.5"	86'11.9"	664' 8"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.7"	15' 4"	20' 7.2"	54' 0.2"	117' 7.3"	∞
f/2.8	NEAR	2'11.8"	4'11.4"	6'10.9"	9' 9.7"	14' 6.7"	19' 2.6"	45' 3.4"	82' 8.3"	474'10.1"
	FAR	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.4"	15' 5.6"	20'10.2"	55' 9.8"	126' 6.2"	∞
f/3.5	NEAR	2'11.8"	4'11.3"	6'10.6"	9' 9.1"	14' 5.4"	19' 0.3"	44' 2.9"	79' 3.1"	379'11.2"
	FAR	3' 0.2"	5' 0.7"	7' 1.5"	10' 3.1"	15' 7.1"	21' 0.9"	57' 5.9"	135' 6.1"	∞
f/4	NEAR	2'11.7"	4'11.2"	6'10.4"	9' 8.7"	14' 4.5"	18'10.8"	43' 6.4"	76'11.8"	332' 5.8"
	FAR	3' 0.3"	5' 0.8"	7' 1.7"	10' 3.5"	15' 8.2"	21' 2.9"	58' 9"	142' 9.1"	∞
f/5.6	NEAR	2'11.6"	4'10.9"	6' 9.8"	9' 7.4"	14' 1.7"	18' 5.9"	41' 4.7"	70' 6"	237' 6.8"
	FAR	3' 0.4"	5' 1.1"	7' 2.4"	10' 5"	15'11.7"	21' 9.4"	63' 2.1"	172' 3.1"	∞
f/8	NEAR	2'11.5"	4'10.4"	6' 8.9"	9' 5.6"	13' 9.6"	17'10.9"	38' 6.6"	62' 7.2"	166' 4.7"
	FAR	3' 0.5"	5' 1.6"	7' 3.4"	10' 7.2"	16' 5.1"	22' 7.8"	71' 2.7"	249' 8.9"	∞
f/11	NEAR	2'11.3"	4' 9.9"	6' 7.8"	9' 3.3"	13' 4.9"	17' 2.8"	35' 6.1"	54'11"	121' 1.1"
	FAR	3' 0.7"	5' 2.3"	7' 4.7"	10'10.2"	17' 0.5"	23'10.1"	84' 9"	571' 4.4"	∞
f/16	NEAR	2'11"	4' 9"	6' 6"	8'11.8"	12' 9.5"	16' 2.7"	31' 4.7"	45' 7.2"	83' 4.1"
	FAR	3' 1.1"	5' 3.4"	7' 7.1"	11' 3.4"	18' 2"	26' 1.6"	124' 1.2"	∞	∞
f/22	NEAR	2'10.6"	4' 7.9"	6' 4"	8' 7.9"	12' 1.5"	15' 1.8"	27' 6.7"	37'10.9"	60' 8.3"
	FAR	3' 1.5"	5' 4.8"	7'10.1"	11'10.3"	19' 8.8"	29' 6.5"	281' 0.7"	∞	∞
f/32	NEAR	2'10"	4' 6.3"	6' 0.8"	8' 1.9"	11' 1.9"	13' 7.9"	22'11"	29' 7.3"	41' 9.8"
	FAR	3' 2.2"	5' 7.2"	8' 3.5"	12'11.5"	23' 0.8"	37' 9.5"	∞	∞	∞
f/45	NEAR	2' 9.3"	4' 4.2"	5' 9.1"	7' 7.2"	10' 1.3"	12' 1.4"	18' 9.8"	23' 0.9"	29' 9.9"
	FAR	3' 3.3"	5'10.7"	8'11.7"	14' 9"	29' 7.1"	59' 6.3"	∞	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.7"	14' 9.1"	19' 6.8"	47' 4"	89' 9.7"	875' 2.6"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.3"	15' 3"	20' 5.4"	52'11.9"	112' 9.8"	∞
f/1.8	NEAR	2'11.9"	4'11.6"	6'11.3"	9'10.5"	14' 8.5"	19' 5.8"	46'10"	88' 0.2"	729' 4.8"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.6"	20' 6.5"	53' 7.6"	115' 9.4"	∞
f/1.9	NEAR	2'11.9"	4'11.6"	6'11.2"	9'10.4"	14' 8.3"	19' 5.5"	46' 8"	87' 5.2"	691' 0.4"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.8"	20' 6.9"	53'10.2"	116' 9.7"	∞
f/2	NEAR	2'11.9"	4'11.6"	6'11.2"	9'10.3"	14' 8.1"	19' 5.1"	46' 6.1"	86'10.3"	656' 6"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.7"	15' 4"	20' 7.3"	54' 0.8"	117'10.2"	∞
f/2.8	NEAR	2'11.8"	4'11.4"	6'10.9"	9' 9.7"	14' 6.7"	19' 2.5"	45' 2.9"	82' 6.3"	469' 0.2"
	FAR	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.4"	15' 5.7"	20'10.3"	55'10.7"	126'11.1"	∞
f/3.5	NEAR	2'11.8"	4'11.3"	6'10.6"	9' 9.1"	14' 5.4"	19' 0.2"	44' 2.3"	79' 0.8"	375' 3.4"
	FAR	3' 0.2"	5' 0.7"	7' 1.5"	10' 3.1"	15' 7.2"	21' 1.1"	57' 7"	136' 1.1"	∞
f/4	NEAR	2'11.7"	4'11.2"	6'10.4"	9' 8.7"	14' 4.5"	18'10.6"	43' 5.6"	76' 9.3"	328' 4.9"
	FAR	3' 0.2"	5' 0.8"	7' 1.7"	10' 3.5"	15' 8.2"	21' 3.1"	58'10.3"	143' 5.9"	∞
f/5.6	NEAR	2'11.6"	4'10.9"	6' 9.8"	9' 7.4"	14' 1.6"	18' 5.7"	41' 3.8"	70' 3.1"	234' 8.1"
	FAR	3' 0.4"	5' 1.1"	7' 2.4"	10' 5"	15'11.8"	21' 9.6"	63' 4.3"	173' 9.2"	∞
f/8	NEAR	2'11.5"	4'10.4"	6' 8.9"	9' 5.5"	13' 9.5"	17'10.7"	38' 5.5"	62' 3.9"	164' 4.4"
	FAR	3' 0.5"	5' 1.6"	7' 3.4"	10' 7.3"	16' 5.3"	22' 8.2"	71' 6.9"	254' 4"	∞
f/11	NEAR	2'11.3"	4' 9.9"	6' 7.8"	9' 3.3"	13' 4.7"	17' 2.6"	35' 4.8"	54' 7.6"	119' 7.6"
	FAR	3' 0.7"	5' 2.3"	7' 4.8"	10'10.2"	17' 0.7"	23'10.6"	85' 5.2"	606' 0.6"	∞
f/16	NEAR	2'11"	4' 9"	6' 6"	8'11.8"	12' 9.3"	16' 2.3"	31' 3.2"	45' 3.9"	82' 4.2"
	FAR	3' 1.1"	5' 3.4"	7' 7.1"	11' 3.5"	18' 2.4"	26' 2.5"	126' 3.3"	∞	∞
f/22	NEAR	2'10.6"	4' 7.9"	6' 4"	8' 7.8"	12' 1.2"	15' 1.5"	27' 5.2"	37' 7.7"	59'11.8"
	FAR	3' 1.5"	5' 4.8"	7'10.1"	11'10.5"	19' 9.4"	29' 8.2"	297' 2.8"	∞	∞
f/32	NEAR	2'10"	4' 6.3"	6' 0.8"	8' 1.9"	11' 1.6"	13' 7.5"	22' 9.5"	29' 4.6"	41' 4.1"
	FAR	3' 2.2"	5' 7.2"	8' 3.6"	12'11.8"	23' 2.1"	38' 1.6"	∞	∞	∞
f/45	NEAR	2' 9.3"	4' 4.3"	5' 9.1"	7' 7.1"	10' 1.1"	12' 0.9"	18' 8.4"	22'10.7"	29' 5.9"
	FAR	3' 3.2"	5'10.7"	8'11.8"	14' 9.6"	29'10.3"	60' 9.3"	∞	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.8"	6'11.5"	9'11"	14' 9.7"	19' 7.8"	47'10.1"	91' 8.1"	1093'11.3
	FAR	3' 0.1"	5' 0.2"	7' 0.5"	10' 1"	15' 2.4"	20' 4.3"	52' 4.4"	109'11.9"	∞
f/1.8	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.8"	14' 9.2"	19' 7"	47' 5.2"	90' 2.1"	911' 8.1"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.2"	15' 2.9"	20' 5.2"	52'10.4"	112' 2.9"	∞
f/1.9	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.7"	14' 9.1"	19' 6.7"	47' 3.6"	89' 8.2"	863' 8.5"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.3"	15' 3"	20' 5.5"	53' 0.4"	113' 0.1"	∞
f/2	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.6"	14' 8.9"	19' 6.5"	47' 2"	89' 2.4"	820' 6.5"
	FAR	3' 0.1"	5' 0.3"	7' 0.7"	10' 1.4"	15' 3.2"	20' 5.8"	53' 2.4"	113' 9.5"	∞
f/2.8	NEAR	2'11.8"	4'11.6"	6'11.1"	9'10.1"	14' 7.7"	19' 4.3"	46' 1.4"	85' 6.1"	586' 2.3"
	FAR	3' 0.1"	5' 0.5"	7' 0.9"	10' 1.9"	15' 4.5"	20' 8.2"	54' 7.2"	120' 5.2"	∞
f/3.5	NEAR	2'11.8"	4'11.4"	6'10.9"	9' 9.7"	14' 6.7"	19' 2.5"	45' 2.9"	82' 6.3"	469' 0.2"
	FAR	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.4"	15' 5.7"	20'10.3"	55'10.7"	126'11.1"	∞
f/4	NEAR	2'11.8"	4'11.4"	6'10.7"	9' 9.3"	14' 5.9"	19' 1.2"	44' 7.6"	80' 6.1"	410' 5.2"
	FAR	3' 0.2"	5' 0.6"	7' 1.3"	10' 2.8"	15' 6.5"	20'11.9"	56'10.1"	132'	∞
f/5.6	NEAR	2'11.7"	4'11.1"	6'10.2"	9' 8.3"	14' 3.6"	18' 9.1"	42' 9.6"	74' 8.4"	293' 3.1"
	FAR	3' 0.3"	5' 0.9"	7' 1.9"	10' 4"	15' 9.3"	21' 5"	60' 1.7"	151' 4.9"	∞
f/8	NEAR	2'11.6"	4'10.8"	6' 9.5"	9' 6.8"	14' 0.2"	18' 3.3"	40' 3.8"	67' 4.8"	205' 4.6"
	FAR	3' 0.4"	5' 1.3"	7' 2.7"	10' 5.7"	16' 1.6"	22' 1.1"	65'10.5"	194' 3.3"	∞
f/11	NEAR	2'11.4"	4'10.3"	6' 8.6"	9' 4.9"	13' 8.2"	17' 8.5"	37' 7.1"	60' 0.8"	149' 5.5"
	FAR	3' 0.6"	5' 1.8"	7' 3.8"	10' 8"	16' 7.2"	22'11.9"	74' 9.7"	300'10.4"	∞
f/16	NEAR	2'11.2"	4' 9.6"	6' 7.1"	9' 2"	13' 2"	16'10"	33' 9.5"	50'10.4"	102'10.3"
	FAR	3' 0.8"	5' 2.7"	7' 5.6"	11' 0.1"	17' 5.4"	24' 8"	96' 8.2"	3580' 6"	∞
f/22	NEAR	2'10.9"	4' 8.7"	6' 5.4"	8'10.7"	12' 7.1"	15'10.7"	30' 1.7"	42'11.8"	74'10.7"
	FAR	3' 1.2"	5' 3.7"	7' 7.9"	11' 5.3"	18' 7.1"	27' 0.6"	149' 1.4"	∞	∞
f/32	NEAR	2'10.4"	4' 7.3"	6' 2.8"	8' 5.6"	11' 8.8"	14' 6.5"	25' 6.7"	34' 2.2"	51' 7.1"
	FAR	3' 1.7"	5' 5.6"	8'	12' 3"	20'10.6"	32' 3"	1600' 7"	∞	∞
f/45	NEAR	2' 9.8"	4' 5.6"	5'11.6"	7'11.7"	10' 9.5"	13' 1.3"	21' 4.2"	27' 0.2"	36' 9.4"
	FAR	3' 2.5"	5' 8.2"	8' 6"	13' 5.9"	24'10.6"	43' 0.7"	∞	∞	∞

135MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.8"	6'11.7"	9'11.3"	14'10.4"	19' 9.2"	48' 6.1"	94' 1.8"	1594'11.2"
	FAR	3'	5' 0.2"	7' 0.3"	10' 0.7"	15' 1.6"	20' 2.9"	51' 7.1"	106' 7.6"	∞
f/1.8	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11.2"	14'10.1"	19' 8.6"	48' 2.6"	93' 0.7"	1329' 2.2"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.8"	15' 1.9"	20' 3.5"	51'11"	108' 0.8"	∞
f/1.9	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11.1"	14'10"	19' 8.4"	48' 1.5"	92' 8.4"	1259' 3"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.9"	15' 2"	20' 3.7"	52' 0.4"	108' 6.6"	∞
f/2	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11.1"	14' 9.9"	19' 8.2"	48' 0.3"	92' 4.2"	1196' 3.7"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.9"	15' 2.2"	20' 3.9"	52' 1.7"	109' 0.5"	∞
f/2.8	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.7"	14' 9.1"	19' 6.7"	47' 3.4"	89' 7.3"	854' 7.6"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.3"	15' 3"	20' 5.5"	53' 0.6"	113' 1.6"	∞
f/3.5	NEAR	2'11.9"	4'11.6"	6'11.3"	9'10.4"	14' 8.4"	19' 5.5"	46' 7.8"	87' 4.1"	683' 9.5"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.8"	20' 6.9"	53'10.5"	116'11.7"	∞
f/4	NEAR	2'11.9"	4'11.6"	6'11.2"	9'10.2"	14' 7.8"	19' 4.6"	46' 2.5"	85' 9.5"	598' 4.5"
	FAR	3' 0.1"	5' 0.4"	7' 0.9"	10' 1.9"	15' 4.4"	20' 7.9"	54' 5.7"	119'10.7"	∞
f/5.6	NEAR	2'11.8"	4'11.4"	6'10.8"	9' 9.5"	14' 6.2"	19' 1.7"	44'10.2"	81' 2.2"	427' 6.5"
	FAR	3' 0.2"	5' 0.6"	7' 1.2"	10' 2.6"	15' 6.2"	20'11.3"	56' 6.1"	130' 3.1"	∞
f/8	NEAR	2'11.7"	4'11.2"	6'10.3"	9' 8.4"	14' 3.9"	18' 9.6"	42'11.4"	75' 1.6"	299' 4.9"
	FAR	3' 0.2"	5' 0.8"	7' 1.8"	10' 3.8"	15' 8.9"	21' 4.4"	59'10.2"	149' 8.5"	∞
f/11	NEAR	2'11.6"	4'10.9"	6' 9.7"	9' 7.2"	14' 1"	18' 4.6"	40' 9.6"	68' 8.8"	217'10.5"
	FAR	3' 0.3"	5' 1.2"	7' 2.5"	10' 5.3"	16' 0.5"	21'11.2"	64' 7.6"	184' 1"	∞
f/16	NEAR	2'11.5"	4'10.4"	6' 8.7"	9' 5.1"	13' 8.5"	17' 8.8"	37' 7.9"	60' 2.4"	149'11.1"
	FAR	3' 0.5"	5' 1.7"	7' 3.6"	10' 7.8"	16' 6.8"	22'11.3"	74' 6.9"	298' 6.3"	∞
f/22	NEAR	2'11.3"	4' 9.8"	6' 7.5"	9' 2.7"	13' 3.4"	17' 0.2"	34' 5.8"	52' 4.9"	109' 1.9"
	FAR	3' 0.7"	5' 2.4"	7' 5.1"	10'11.1"	17' 3"	24' 3.5"	91' 6.2"	1182' 3.5"	∞
f/32	NEAR	2'11"	4' 8.9"	6' 5.7"	8'11"	12' 7.5"	15'11.3"	30' 2.9"	43' 1.6"	75' 2.2"
	FAR	3' 1.1"	5' 3.6"	7' 7.6"	11' 4.8"	18' 6.3"	26'11.2"	147' 6.2"	∞	∞
f/45	NEAR	2'10.6"	4' 7.7"	6' 3.4"	8' 6.5"	11'10.4"	14' 8.9"	26' 1.1"	35' 1.1"	53' 7.1"
	FAR	3' 1.5"	5' 5.1"	7'11.1"	12' 1.1"	20' 5.9"	31' 4.6"	733' 7.4"	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	2'11.9"	4'11.9"	6'11.8"	9'11.5"	14'10.7"	19' 9.7"	48' 9.6"	95' 3.2"	1993' 6.6"
	FAR	3'	5' 0.1"	7' 0.3"	10' 0.6"	15' 1.3"	20' 2.3"	51' 3.2"	105' 2.8"	∞
f/1.8	NEAR	2'11.9"	4'11.9"	6'11.7"	9'11.3"	14'10.5"	19' 9.3"	48' 6.8"	94' 4.4"	1661' 4.4"
	FAR	3'	5' 0.2"	7' 0.3"	10' 0.7"	15' 1.5"	20' 2.8"	51' 6.3"	106' 4.2"	∞
f/1.9	NEAR	2'11.9"	4'11.8"	6'11.7"	9'11.3"	14'10.4"	19' 9.1"	48' 5.8"	94' 0.9"	1573'11.4"
	FAR	3'	5' 0.2"	7' 0.3"	10' 0.7"	15' 1.6"	20' 3"	51' 7.3"	106' 8.7"	∞
f/2	NEAR	2'11.9"	4'11.8"	6'11.7"	9'11.3"	14'10.3"	19' 9"	48' 4.9"	93' 9.4"	1495' 3.3"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.7"	15' 1.7"	20' 3.1"	51' 8.4"	107' 1.2"	∞
f/2.8	NEAR	2'11.9"	4'11.8"	6'11.5"	9'11"	14' 9.7"	19' 7.8"	47' 9.6"	91' 6.1"	1068' 2.2"
	FAR	3' 0.1"	5' 0.2"	7' 0.5"	10' 1"	15' 2.4"	20' 4.4"	52' 4.9"	110' 2.8"	∞
f/3.5	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.7"	14' 9.1"	19' 6.7"	47' 3.4"	89' 7.3"	854' 7.6"
	FAR	3' 0.1"	5' 0.3"	7' 0.6"	10' 1.3"	15' 3"	20' 5.5"	53' 0.6"	113' 1.6"	∞
f/4	NEAR	2'11.9"	4'11.7"	6'11.3"	9'10.6"	14' 8.7"	19' 6"	46'11"	88' 3.6"	747'10.3"
	FAR	3' 0.1"	5' 0.3"	7' 0.7"	10' 1.5"	15' 3.5"	20' 6.3"	53' 6.2"	115' 3.6"	∞
f/5.6	NEAR	2'11.8"	4'11.5"	6'11.1"	9'10"	14' 7.4"	19' 3.7"	45' 9.5"	84' 4.2"	534' 3.7"
	FAR	3' 0.1"	5' 0.5"	7' 1"	10' 2.1"	15' 4.9"	20' 8.9"	55' 0.9"	122' 9.9"	∞
f/8	NEAR	2'11.8"	4'11.3"	6'10.7"	9' 9.1"	14' 5.5"	19' 0.3"	44' 2.4"	79' 0.7"	374' 1.8"
	FAR	3' 0.2"	5' 0.7"	7' 1.4"	10' 3"	15' 7.1"	21' 1"	57' 6.9"	136' 1.8"	∞
f/11	NEAR	2'11.7"	4'11.1"	6'10.2"	9' 8.1"	14' 3.1"	18' 8.2"	42' 4.3"	73' 3.7"	272' 2.8"
	FAR	3' 0.3"	5' 0.9"	7' 2"	10' 4.2"	15' 9.9"	21' 6.2"	61' 0.6"	157' 6.6"	∞
f/16	NEAR	2'11.6"	4'10.7"	6' 9.3"	9' 6.4"	13'11.4"	18' 1.8"	39' 7.3"	65' 4.7"	187' 3.6"
	FAR	3' 0.4"	5' 1.4"	7' 2.9"	10' 6.2"	16' 2.8"	22' 3.4"	67'10.7"	213' 6.5"	∞
f/22	NEAR	2'11.4"	4'10.2"	6' 8.4"	9' 4.5"	13' 7.1"	17' 6.5"	36' 9.1"	57'10.8"	136' 4"
	FAR	3' 0.6"	5' 1.9"	7' 4"	10' 8.7"	16' 9"	23' 3.5"	78' 5.3"	372' 9.2"	∞
f/32	NEAR	2'11.2"	4' 9.5"	6' 6.9"	9' 1.4"	13' 0.5"	16' 7.4"	32' 9.9"	48' 7.7"	93'10.4"
	FAR	3' 0.8"	5' 2.8"	7' 6"	11' 1.1"	17' 8.2"	25' 2.1"	105'11.8"	∞	∞
f/45	NEAR	2'10.8"	4' 8.5"	6' 4.9"	8' 9.6"	12' 4.6"	15' 6.6"	28' 9.9"	40' 3.5"	66'10.6"
	FAR	3' 1.2"	5' 4"	7' 8.6"	11' 7.3"	19' 1"	28' 1.9"	195' 5.9"	∞	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	3'	4'11.9"	6'11.8"	9'11.6"	14'11.1"	19'10.4"	49' 1.8"	96' 7.6"	2835' 2.8"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.4"	15' 0.9"	20' 1.6"	50'10.5"	103' 7.4"	∞
f/1.8	NEAR	3'	4'11.9"	6'11.8"	9'11.6"	14'11"	19'10.1"	48'11.9"	95'11.8"	2362' 9.5"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.5"	15' 1.1"	20' 1.9"	51' 0.7"	104' 4.4"	∞
f/1.9	NEAR	3'	4'11.9"	6'11.8"	9'11.5"	14'10.9"	19'10"	48'11.2"	95' 9.3"	2238' 5.6"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.5"	15' 1.1"	20' 2"	51' 1.4"	104' 7.5"	∞
f/2	NEAR	3'	4'11.9"	6'11.8"	9'11.5"	14'10.8"	19' 9.9"	48'10.5"	95' 6.7"	2126' 6.9"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.5"	15' 1.2"	20' 2.1"	51' 2.1"	104'10.5"	∞
f/2.8	NEAR	2'11.9"	4'11.8"	6'11.7"	9'11.3"	14'10.4"	19' 9.1"	48' 5.3"	93'10.7"	1519' 1.8"
	FAR	3'	5' 0.2"	7' 0.3"	10' 0.7"	15' 1.7"	20' 3"	51' 7.9"	106'11.6"	∞
f/3.5	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11.1"	14'10"	19' 8.3"	48' 0.8"	92' 5.8"	1215' 5.3"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.9"	15' 2.1"	20' 3.8"	52' 1.1"	108'10.3"	∞
f/4	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11"	14' 9.7"	19' 7.8"	47' 9.7"	91' 6"	1063' 7"
	FAR	3'	5' 0.2"	7' 0.5"	10' 1"	15' 2.4"	20' 4.3"	52' 4.9"	110' 3.1"	∞
f/5.6	NEAR	2'11.9"	4'11.7"	6'11.4"	9'10.6"	14' 8.8"	19' 6.2"	46'11.8"	88' 5.9"	759'10.4"
	FAR	3' 0.1"	5' 0.3"	7' 0.7"	10' 1.4"	15' 3.3"	20' 6.1"	53' 5.3"	114'11.7"	∞
f/8	NEAR	2'11.9"	4'11.6"	6'11.1"	9'10"	14' 7.4"	19' 3.8"	45' 9.6"	84' 4"	532' 1"
	FAR	3' 0.1"	5' 0.4"	7' 1"	10' 2"	15' 4.8"	20' 8.8"	55' 0.8"	122'10.5"	∞
f/11	NEAR	2'11.8"	4'11.4"	6'10.8"	9' 9.3"	14' 5.8"	19' 0.9"	44' 4.8"	79' 8"	387' 1.6"
	FAR	3' 0.2"	5' 0.6"	7' 1.3"	10' 2.8"	15' 6.7"	21' 0.3"	57' 2.9"	134' 5"	∞
f/16	NEAR	2'11.7"	4'11.1"	6'10.2"	9' 8.1"	14' 3.1"	18' 8.1"	42' 3"	72'11.2"	266' 4.1"
	FAR	3' 0.2"	5' 0.9"	7' 1.9"	10' 4.1	15' 9.9"	21' 6.4"	61' 3.4"	159' 4.9"	∞
f/22	NEAR	2'11.6"	4'10.8"	6' 9.5"	9' 6.8"	14'	18' 2.7"	39'11.3"	66' 2.8"	193'10.3"
	FAR	3' 0.3"	5' 1.2"	7' 2.7"	10' 5.8"	16' 1.9"	22' 2"	66'11.6"	205' 3.4"	∞
f/32	NEAR	2'11.5"	4'10.3"	6' 8.5"	9' 4.5"	13' 7.1"	17' 6.3"	36' 7.3"	57' 5.5"	133' 5.6"
	FAR	3' 0.5"	5' 1.8"	7' 3.9"	10' 8.6"	16' 9"	23' 3.8"	79' 3"	395' 3.7"	∞
f/45	NEAR	2'11.3"	4' 9.6"	6' 7.1"	9' 1.8"	13' 1.1"	16' 8.3"	33' 0.4"	49' 0.4"	95' 0.9"
	FAR	3' 0.7"	5' 2.6"	7' 5.6"	11' 0.5"	17' 7.1"	25' 0.2"	104' 1.9"	∞	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		3 ft.	5 ft.	7 ft.	10 ft.	15 ft.	20 ft.	50 ft.	100 ft.	Inf.
f/1.5	NEAR	3'	4'11.9"	6'11.9"	9'11.7"	14'11.3"	19'10.7"	49' 3.8"	97' 3.4"	3543'10.8"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.3"	15' 0.7"	20' 1.3"	50' 8.4"	102'10.4"	∞
f/1.8	NEAR	3'	4'11.9"	6'11.8"	9'11.6"	14'11.2"	19'10.5"	49' 2.2"	96' 9.1"	2953' 4.2"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.4"	15' 0.8"	20' 1.5"	50'10.1"	103' 5.6"	∞
f/1.9	NEAR	3'	4'11.9"	6'11.8"	9'11.6"	14'11.1"	19'10.4"	49' 1.7"	96' 7.1"	2797'11.3"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.4"	15' 0.9"	20' 1.6"	50'10.7"	103' 8"	∞
f/2	NEAR	3'	4'11.9"	6'11.8"	9'11.6"	14'11.1"	19'10.3"	49' 1.2"	96' 5"	2658' 0.9"
	FAR	3'	5' 0.1"	7' 0.2"	10' 0.4"	15' 0.9"	20' 1.7"	50'11.2"	103'10.4"	∞
f/2.8	NEAR	2'11.9"	4'11.9"	6'11.8"	9'11.4"	14'10.7"	19' 9.6"	48' 9"	95' 0.6"	1898' 9.5"
	FAR	3'	5' 0.1"	7' 0.3"	10' 0.6"	15' 1.3"	20' 2.4"	51' 3.8"	105' 5.9"	∞
f/3.5	NEAR	2'11.9"	4'11.8"	6'11.7"	9'11.3"	14'10.4"	19' 9.1"	48' 5.3"	93'10.7"	1519' 1.8"
	FAR	3'	5' 0.2"	7' 0.3"	10' 0.7"	15' 1.7"	20' 3"	51' 7.9"	106'11.6"	∞
f/4	NEAR	2'11.9"	4'11.8"	6'11.6"	9'11.2"	14'10.1"	19' 8.6"	48' 2.7"	93' 1"	1329' 4"
	FAR	3'	5' 0.2"	7' 0.4"	10' 0.8"	15' 1.9"	20' 3.5"	51'10.9"	108' 0.5"	∞
f/5.6	NEAR	2'11.9"	4'11.8"	6'11.5"	9'10.9"	14' 9.4"	19' 7.3"	47' 6.7"	90' 6.9"	949' 8.3"
	FAR	3' 0.1"	5' 0.2"	7' 0.5"	10' 1.1"	15' 2.7"	20' 4.9"	52' 8.6"	111' 7.6"	∞
f/8	NEAR	2'11.9"	4'11.7"	6'11.3"	9'10.4"	14' 8.3"	19' 5.4"	46' 7"	87' 0.7"	664'11.5"
	FAR	3' 0.1"	5' 0.4"	7' 0.8"	10' 1.6"	15' 3.8"	20' 7"	53'11.6"	117' 5.9"	∞
f/11	NEAR	2'11.8"	4'11.5"	6'11"	9' 9.8"	14' 7"	19' 3"	45' 5"	83' 0.4"	483' 9.2"
	FAR	3' 0.1"	5' 0.5"	7' 1.1"	10' 2.2"	15' 5.3"	20' 9.7"	55' 7.5"	125' 9"	∞
f/16	NEAR	2'11.8"	4'11.3"	6'10.6"	9' 8.9"	14' 4.8"	18'11.1"	43' 7.2"	77' 1.2"	332' 9.3"
	FAR	3' 0.2"	5' 0.7"	7' 1.5"	10' 3.3"	15' 7.8"	21' 2.5"	58' 7.6"	142' 5.4"	∞
f/22	NEAR	2'11.7"	4'11.1"	6'10"	9' 7.8"	14' 2.3"	18' 6.7"	41' 7.3"	71' 0.2"	242' 2.2"
	FAR	3' 0.3"	5' 1"	7' 2.1"	10' 4.6"	15'11"	21' 8.3"	62' 8.4"	169' 6.1"	∞
f/32	NEAR	2'11.6"	4'10.6"	6' 9.2"	9' 5.9"	13'10.2"	17'11.6"	38' 8.1"	62' 9.3"	166' 8.2"
	FAR	3' 0.4"	5' 1.4"	7' 3.1"	10' 6.8"	16' 4.4"	22' 6.8"	70'11.1"	248' 2.4"	∞
f/45	NEAR	2'11.4"	4'10.1"	6' 8.1"	9' 3.7"	13' 5.2"	17' 3.1"	35' 5.1"	54' 6.8"	118' 8.4"
	FAR	3' 0.6"	5' 2.1"	7' 4.4"	10' 9.8"	17'	23' 9.8"	85' 6.4"	628' 5.3"	∞

300MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	6'11.9"	9'11.8"	14'11.6"	19'11.3"	29'10.4"	49' 7.4"	98' 5.4"	193' 9.9"	6217' 3.7"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.7"	30' 1.6"	50' 4.7"	101' 7.2"	206' 7"	∞
f/2	NEAR	6'11.9"	9'11.8"	14'11.6"	19'11.3"	29'10.3"	49' 7.2"	98' 4.4"	193' 6.1"	5906' 6"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.7"	30' 1.7"	50' 4.9"	101' 8.3"	206'11.3"	∞
f/2.5	NEAR	6'11.9"	9'11.8"	14'11.5"	19'11.1"	29\ 9.9"	49' 6"	97'11.6"	191'11.5"	4725' 4.7"
	FAR	7' 0.1"	10' 0.2"	15' 0.5"	20' 0.9"	30' 2.2"	50' 6.2"	102' 1.4"	208' 9"	∞
f/2.8	NEAR	6'11.9"	9'11.8"	14'11.4"	19'11"	29' 9.6"	49' 5.2"	97' 8.7"	191' 0.4"	4219' 2.5"
	FAR	7' 0.1"	10' 0.2"	15' 0.6"	20' 1"	30' 2.4"	50' 6.9"	102' 4.6"	209'10.3"	∞
f/3.5	NEAR	6'11.9"	9'11.7"	14'11.3"	19'10.7"	29' 9"	49' 3.6"	97' 2.1"	188'11"	3375' 6.7"
	FAR	7' 0.1"	10' 0.3"	15' 0.7"	20' 1.3"	30' 3"	50' 8.7"	102'11.9"	212' 5.7"	∞
f/4	NEAR	6'11.9"	9'11.7"	14'11.2"	19'10.5"	29' 8.6"	49' 2.4"	96' 9.4"	187' 5.2"	2953' 8.9"
	FAR	7' 0.2"	10' 0.3"	15' 0.8"	20' 1.5"	30' 3.5"	50' 9.9"	103' 5.2"	214' 4.6"	∞
f/5.6	NEAR	6'11.8"	9'11.5"	14'10.9"	19'10"	29' 7.3"	48'10.6"	95' 6.7"	182'10.1"	2110' 1.1"
	FAR	7' 0.2"	10' 0.5"	15' 1.1"	20' 2.1"	30' 4.9"	51' 2"	104'10.5"	220' 8.8"	∞
f/6.3	NEAR	6'11.8"	9'11.5"	14'10.8"	19' 9.7"	29' 6.7"	48' 9"	95' 0.4"	180'10.8"	1875' 9"
	FAR	7' 0.2"	10' 0.5"	15' 1.3"	20' 2.3"	30' 5.5"	51' 3.8"	105' 6.3"	223' 7.6"	∞
f/8	NEAR	6'11.7"	9.11.3"	14'10.4"	19' 9.1"	29' 5.3"	48' 5.1"	93' 9.3"	176' 4.3"	1477' 4.3"
	FAR	7' 0.3"	10' 0.7"	15' 1.6"	20' 3"	30' 7"	51' 8.2"	107' 1.4"	231' 0.1"	∞
f/11	NEAR	6'11.6"	9.11.1"	14' 9.8"	19' 8"	29' 2.8"	47'10.3"	91' 7.7"	168'10.6"	1074' 8.6"
	FAR	7' 0.4"	10' 0.9"	15' 2.2"	20' 4.1"	30' 9.7"	52' 4.1"	110' 0.7"	245' 3.4"	∞
f/16	NEAR	6'11.4"	9'10.7"	14' 8.9"	19' 6.3"	28'10.8"	46'11.4"	88' 3.5"	157' 8.9"	739' 2.1"
	FAR	7' 0.6"	10' 1.3"	15' 3.3"	20' 6"	31' 2.2"	53' 5.8"	115' 4.1"	273' 5.5"	∞
f/22	NEAR	6'11.2"	9'10.2"	14' 7.7"	19' 4.2"	28' 6.1"	45'10.8"	84' 7"	146' 2.1"	537'10.2"
	FAR	7' 0.8"	10' 1.8"	15' 4.5"	20' 8.4"	31' 7.9"	54'11.1"	122' 4.7"	317' 2.8"	∞
f/32	NEAR	6'10.9"	9' 9.4"	14' 5.8"	19' 0.8"	27'10.6"	44' 3"	79' 0.7"	130' 3.4"	370' 0.9"
	FAR	7' 1.2"	10' 2.7"	15' 6.6"	21' 0.4"	32' 5.7"	57' 6.1"	136' 3.6"	432'10.5"	∞
f/45	NEAR	6'10.4"	9' 8.4"	14' 3.5"	18' 8.6"	27' 1.3"	42' 3.4"	72'10.5"	114' 2.1"	263' 5.4"
	FAR	7' 1.7"	10' 3.8"	15' 9.5"	21' 5.8"	33' 7.3"	61' 3.1"	159'11.8"	824' 2.6"	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.7"	49' 8.3"	98' 9"	195' 0.4"	7771' 4.7"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.3"	50' 3.7"	101' 3.3"	205' 2.8"	∞
f/2	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.6"	49' 8.1"	98' 8.3"	194' 9.3"	7382'10.5"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.4"	50' 3.9"	101' 4.2"	205' 6.2"	∞
f/2.5	NEAR	6'11.9"	9'11.8"	14'11.6"	19'11.3"	29'10.3"	49' 7.2"	98' 4.4"	193' 6.1"	5906' 6"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.7"	30' 1.7"	50' 4.9"	101' 8.3"	206'11.3"	∞
f/2.8	NEAR	6'11.9"	9'11.8"	14'11.6"	19'11.2"	29'10.1"	49' 6.6"	98' 2.1"	192' 9.1"	5273' 9.2"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.8"	30' 1.9"	50' 5.5"	101'10.7"	207' 9.7"	∞
f/3.5	NEAR	6'11.9"	9'11.8"	14'11.4"	19'11"	29' 9.6"	49' 5.2"	97' 8.7"	191' 0.4"	4219' 2.5"
	FAR	7' 0.1"	10. 0.2"	15' 0.6"	20' 1"	30' 2.4"	50' 6.9	102' 4.6"	209'10.3"	∞
f/4	NEAR	6'11.9"	9'11.7"	14'11.4"	19'10.8"	29' 9.3"	49' 4.3"	97' 5"	189' 9.8"	3691"11.1"
	FAR	7' 0.1"	10' 0.3"	15' 0.6"	20' 1.2"	30' 2.8"	50' 7.9"	102' 8.8"	211' 4.1"	∞
f/5.6	NEAR	6'11.9"	9'11.6"	14'11.1"	19'10.4"	29' 8.2"	49' 1.3"	96' 5"	186' 0.4"	2637' 4.5"
	FAR	7' 0.2"	10' 0.4"	15' 0.9"	20' 1.7"	30' 3.9"	50'11.1"	103'10.4"	216' 3"	∞
f/6.3	NEAR	6'11.8"	9'11.6"	14'11"	19'10.2"	29' 7.7"	48'11.9"	95'11.8"	184' 5.1"	2344' 5.3"
	FAR	7' 0.2"	10' 0.4"	15' 1"	20' 1.9"	30' 4.4"	51' 0.6"	104' 4.4"	218' 5.6"	∞
f/8	NEAR	6'11.8"	9'11.5"	14'10.7"	19' 9.7"	29' 6.6"	48' 8.8"	94'11.5"	180' 7.5"	1846' 5.5"
	FAR	7' 0.3"	10' 0.5"	15' 1.3"	20' 2.4"	30' 5.6"	51' 4"	105' 7.4"	224' 0.7"	∞
f/11	NEAR	6'11.7"	9'11.3"	14'10.3"	19' 8.8"	29' 4.6"	48' 3.3"	93' 2.4"	174' 3.6"	1343' 1.8"
	FAR	7' 0.3"	10' 0.7"	15' 1.8"	20' 3.3"	30' 7.7"	51'10.3"	107'10.6"	234' 7.8"	∞
f/16	NEAR	6'11.5"	9'11"	14' 9.5"	19' 7.4"	29' 1.4"	47' 6.3"	90' 4.9"	164' 8.3"	923' 8.6"
	FAR	7' 0.5"	10' 1.1"	15' 2.6"	20' 4.8"	30'11.3"	52' 9"	111'10.8"	254' 8.7"	∞
f/22	NEAR	6'11.4"	9'10.6"	14' 8.6"	19' 5.7"	28' 9.6"	46' 8"	87' 3.2"	154' 5.8"	672' 0.8"
	FAR	7' 0.7"	10' 1.5"	15' 3.6"	20' 6.7"	31' 3.7"	53'10.3"	117' 1.7"	283'10.8"	∞
f/32	NEAR	6'11.1"	9' 9.9"	14' 7"	19' 3"	28' 3.4"	45' 3.5"	82' 6.1"	140' 0.3"	462' 4.2"
	FAR	7' 1"	10' 2.2"	15' 5.3"	20' 9.8"	31'11.4"	55' 9.9"	127' 0.7"	350'11.6"	∞
f/45	NEAR	6'10.7"	9' 9.1"	14' 5.1"	18'11.5"	27' 7.7"	43' 7.5"	77' 0.5"	124'10.3"	329' 0.8"
	FAR	7' 1.4"	10' 3.1"	15' 7.5"	21' 2"	32' 9.8"	58' 7.3"	142' 9.6"	506'10.4"	∞

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'11.1"	49' 9.4"	99' 1.5"	196' 5.9"	11052' 6.7"
	FAR	7' 0.1"	10' 0.1"	15' 0.2"	20' 0.4"	30' 0.9"	50' 2.6"	100'10.7"	203' 7.7"	∞
f/2	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'11.1"	49' 9.3"	99' 1"	196' 3.7"	10500'
	FAR	7' 0.1"	10' 0.1"	15' 0.2"	20' 0.4"	30' 0.9"	50' 2.7"	100'11.2"	203'10"	∞
f/2.5	NEAR	7'	9'11.9"	14'11.7"	19'11.5"	29'10.8"	49' 8.6"	98'10.2"	195' 4.9"	8400' 3.1"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.5"	30' 1.2"	50' 3.4"	101' 2.1"	204' 9.8"	∞
f/2.8	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.7"	49' 8.2"	98' 8.6"	194'10.5"	7500' 4.5"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.3"	50' 3.8"	101' 3.8"	205' 4.9"	∞
f/3.5	NEAR	7'	9'11.8"	14'11.6"	19'11.3"	29'10.4"	49' 7.3"	98' 4.8"	193' 7.6"	6000' 6.7"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.7"	30' 1.7"	50' 4.8"	101' 7.8"	206' 9.7"	∞
f/4	NEAR	6'11.9"	9'11.8"	14'11.6"	19'11.2"	29'10.1"	49' 6.6"	98' 2.1"	192' 9"	5250' 7.9"
	FAR	7' 0.1"	10' 0.2"	15' 0.4"	20' 0.8"	30' 1.9"	50' 5.5"	101'10.7"	207' 9.8"	∞
f/5.6	NEAR	6'11.9"	9'11.8"	14'11.4"	19'10.9"	29' 9.4"	49' 4.5"	97' 5.6"	190'	3750'10.1"
	FAR	7' 0.1"	10' 0.2"	15' 0.6"	20' 1.1"	30' 2.7"	50' 7.7"	102' 8"	211' 1.4"	∞
f/6.3	NEAR	6'11.9"	9'11.7"	14'11.3"	19'10.7"	29' 9.1"	49' 3.6"	97' 1.9"	188' 9.9"	3334' 2.7"
	FAR	7' 0.1"	10' 0.3"	15' 0.7"	20' 1.3"	30' 3"	50' 8.7"	103' 0.1"	212' 7.1"	∞
f/8	NEAR	6'11.9"	9'11.7"	14'11.1"	19'10.4"	29' 8.3"	49' 1.4"	96' 5.1"	186' 0.2"	2625'11.8"
	FAR	7' 0.2"	10' 0.3"	15' 0.9"	20' 1.6"	30' 3.8"	50'11"	103'10.3"	216' 3.3"	∞
f/11	NEAR	6'11.8"	9'11.5"	14'10.8"	19' 9.8"	29' 6.9"	48' 9.5"	95' 1.8"	181' 3.2"	1910' 2"
	FAR	7' 0.2"	10' 0.5"	15' 1.2"	20' 2.2"	30' 5.3"	51' 3.3"	105' 4.6"	223' 1"	∞
f/16	NEAR	6'11.7"	9'11.3"	14'10.3"	19' 8.9"	29' 4.6"	48' 3.1"	93' 1.2"	173'10.5"	1313' 7.8"
	FAR	7' 0.3"	10' 0.7"	15' 1.7"	20' 3.2"	30' 7.7"	51'10.5"	108' 0.3"	235' 5.4"	∞
f/22	NEAR	6'11.6"	9'11.1"	14' 9.7"	19' 7.7"	29' 2"	47' 7.6"	90' 9"	165' 9.2"	955' 8.9"
	FAR	7' 0.4"	10' 1"	15' 2.4"	20' 4.5"	30'10.7"	52' 7.4"	111' 4.6"	252' 2.8"	∞
f/32	NEAR	6'11.4"	9'10.6"	14' 8.6"	19' 5.8"	28' 9.6"	46' 7.6"	87' 1.2"	153' 9.8"	657' 5.8"
	FAR	7' 0.6"	10' 1.4"	15' 3.5"	20' 6.6"	31' 3.7"	53'10.8"	117' 5.6"	286' 3.5"	∞
f/45	NEAR	6'11.2"	9'10.1"	14' 7.3"	19' 3.4"	28' 4.1"	45' 4.8"	82' 9.3"	140' 8"	467'11"
	FAR	7' 0.9"	10' 2"	15' 5"	20' 9.4"	31'10.6"	55' 8.1"	126' 5.7"	347' 4.1"	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	7'	9'11.9"	14'11.8"	19'11.7"	29'11.3"	49' 9.9"	99' 3.6"	197' 2.2"	13815' 4.5"
	FAR	7'	10' 0.1"	15' 0.2"	20' 0.3"	30' 0.7"	50' 2.1"	100' 8.5"	202'10.8"	∞
f/2	NEAR	7'	9'11.9"	14'11.8"	19'11.7"	29'11.2"	49' 9.8"	99' 3.2"	197' 0.4"	13124' 8.1"
	FAR	7'	10' 0.1"	15' 0.2"	20' 0.3"	30' 0.8"	50' 2.2"	100' 9"	203' 0.7"	∞
f/2.5	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'11.1"	49' 9.3"	99' 1"	196' 3.7"	10500'
	FAR	7' 0.1"	10' 0.1"	15' 0.2"	20' 0.4"	30' 0.9"	50' 2.7"	100'11.2"	203'10"	∞
f/2.8	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'10.9"	49' 9"	98'11.7"	195'10.5"	9375' 1.7"
	FAR	7' 0.1"	10' 0.1"	15' 0.2"	20' 0.4"	30' 1.1"	50' 3.1"	101' 0.6"	204' 3.6"	∞
f/3.5	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.7"	49' 8.2"	98' 8.6"	194'10.5"	7500' 4.5"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.3"	50' 3.8"	101' 3.8"	205' 4.9"	∞
f/4	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.5"	49' 7.7"	98' 6.5"	194' 1.9"	6562'11.9"
	FAR	7' 0.1"	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.5"	50' 4.4"	101' 6.1"	206' 2.4"	∞
f/5.6	NEAR	6'11.9"	9'11.8"	14'11.5"	19'11.1"	29' 9.9"	49' 6"	97'11.6"	191'11"	4688' 2.7"
	FAR	7' 0.1"	10' 0.2"	15' 0.5"	20' 0.9"	30' 2.1"	50' 6.1"	102' 1.5"	208' 9.5"	∞
f/6.3	NEAR	6'11.9"	9'11.8"	14'11.5"	19'11"	29' 9.6"	49' 5.3"	97' 8.6"	190'11.5"	4167' 5.5"
	FAR	7' 0.1"	10' 0.2"	15' 0.5"	20' 1"	30' 2.4"	50' 6.9"	102' 4.7"	209'11.4"	∞
f/8	NEAR	6'11.9"	9'11.7"	14'11.3"	19'10.7"	29' 9"	49' 3.5"	97' 1.4"	188' 7.9"	3282' 1.8"
	FAR	7' 0.1"	10' 0.3"	15' 0.7"	20' 1.3"	30' 3"	50' 8.8"	103' 0.7"	212' 9.7"	∞
f/11	NEAR	6'11.9"	9'11.6"	14'11.1"	19'10.3"	29' 7.9"	49' 0.3"	96' 1"	184' 8.7"	2387' 4.5"
	FAR	7' 0.2"	10' 0.4"	15' 0.9"	20' 1.8"	30' 4.2"	51' 0.2"	104' 3.1"	218' 0.6"	∞
f/16	NEAR	6'11.8"	9'11.5"	14'10.6"	19' 9.5"	29' 6.1"	48' 7.2"	94' 4.8"	178' 6.4"	1641' 8.8"
	FAR	7' 0.3"	10' 0.6"	15' 1.4"	20' 2.6"	30' 6.1"	51' 5.9"	106' 3.8"	227' 4.6"	∞
f/22	NEAR	6'11.7"	9'11.2"	14'10.1"	19' 8.5"	29' 3.9"	48' 1.1"	92' 5.5"	171' 7.6"	1194' 4.1"
	FAR	7' 0.3"	10' 0.8"	15' 1.9"	20' 3.6"	30' 8.5"	52' 0.9"	108'10.8"	239' 8.4"	∞
f/32	NEAR	6'11.5"	9'10.9"	14' 9.3"	19' 7"	29' 0.4"	47' 3.3"	89' 4.8"	161' 3.1"	821' 6.3"
	FAR	7' 0.5"	10' 1.1"	15' 2.8"	20' 5.2"	31' 0.5"	53' 0.9"	113' 6"	263' 6.2"	∞
f/45	NEAR	6'11.4"	9'10.5"	14' 8.2"	19' 5"	28' 7.9"	46' 3"	85' 8.6"	149' 6.2"	584' 6.9"
	FAR	7' 0.7"	10' 1.6"	15' 3.9"	20' 7.4"	31' 5.8"	54' 5.2"	120' 1.2"	302' 7.8"	∞

1000MM

DEPTH OF FIELD TABLE FOR GENERAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	7'	10'	15'	20'	29'11.9"	49'11.6"	99'10.4"	199' 5.3"	69073' 7.1"
	FAR	7'	10'	15'	20'	30' 0.1"	50' 0.4"	100' 1.6"	200' 6.7"	∞
f/2	NEAR	7'	10'	15'	19'11.9"	29'11.9"	49'11.6"	99'10.3"	199' 4.9"	65620' 0.9"
	FAR	7'	10'	15'	20' 0.1"	30' 0.1"	50' 0.4"	100' 1.7"	200' 7.1"	∞
f/2.5	NEAR	7'	10'	15'	19'11.9"	29'11.8"	49'11.5"	99' 9.9"	199' 3.2"	52496' 8.6"
	FAR	7'	10'	15'	20' 0.1"	30' 0.2"	50' 0.5"	100' 2.1"	200' 8.9"	∞
f/2.8	NEAR	7'	10'	15'	19'11.9"	29'11.8"	49'11.4"	99' 9.6"	199' 2.1"	46872' 5.1"
	FAR	7'	10'	15'	20' 0.1"	30' 0.2"	50' 0.6"	100' 2.4"	200' 9.9"	∞
f/3.5	NEAR	7'	10'	15'	19'11.9"	29'11.8"	49'11.3"	99' 9"	198'11.7"	37498' 7.1"
	FAR	7'	10'	15'	20' 0.1"	30' 0.2"	50' 0.7"	100' 3"	201' 0.5"	∞
f/4	NEAR	7'	10'	14'11.9"	19'11.9"	29'11.7"	49'11.2"	99' 8.6"	198' 9.9"	32811' 8.2"
	FAR	7'	10'	15' 0.1"	20' 0.1"	30' 0.3"	50' 0.8"	100' 3.4"	201' 2.2"	∞
f/5.6	NEAR	7'	10'	14'11.9"	19'11.9"	29'11.6"	49'10.8"	99' 7.2"	198' 4.3"	23437'10.2"
	FAR	7'	10'	15' 0.1"	20' 0.1"	30' 0.4"	50' 1.1"	100' 4.8"	201' 8"	∞
f/6.3	NEAR	7'	10'	14'11.9"	19'11.8"	29'11.6"	49'10.7"	99' 6.6"	198' 1.9"	20834' 0.1"
	FAR	7'	10'	15' 0.1"	20' 0.2"	30' 0.4"	50' 1.3"	100' 5.4"	201'10.5"	∞
f/8	NEAR	7'	10'	14'11.9"	19'11.8"	29'11.5"	49'10.4"	99' 5.2"	197' 8"	16407' 5.8"
	FAR	7'	10'	15' 0.1"	20' 0.2"	30' 0.5"	50' 1.6"	100' 6.9"	202' 4.7"	∞
f/11	NEAR	7'	10'	14'11.9"	19'11.7"	29'11.3"	49' 9.8"	99' 2.7"	196' 9.7"	11933' 7.3"
	FAR	7'	10'	15' 0.1"	20' 0.3"	30' 0.7"	50' 2.2"	100' 9.5"	203' 3.6"	∞
f/16	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'11"	49' 8.8"	98'10.5"	195' 4.7"	8205' 4.6"
	FAR	7'	10' 0.1"	15' 0.2"	20' 0.4"	30' 1"	50' 3.2"	101' 1.8"	204'10"	∞
f/22	NEAR	7'	9'11.9"	14'11.7"	19'11.4"	29'10.6"	49' 7.6"	98' 5.5"	193' 8.6"	5968' 5.3"
	FAR	7'	10' 0.1"	15' 0.3"	20' 0.6"	30' 1.4"	50' 4.4"	101' 7.1"	206' 8.5"	∞
f/32	NEAR	7'	9'11.9"	14'11.6"	19'11.2"	29' 9.9"	49' 5.7"	97' 9.3"	190'11.9"	4104' 4"
	FAR	7' 0.1"	10' 0.1"	15' 0.4"	20' 0.8"	30' 2.1"	50' 6.5"	102' 4"	209'10.9"	∞
f/45	NEAR	7'	9'11.8"	14'11.4"	19'10.9"	29' 9.1"	49' 3.2"	96'10.7"	187' 6.8"	2919' 7"
	FAR	7' 0.1"	10' 0.2"	15' 0.6"	20' 1.2"	30' 3"	50' 9.1"	103' 3.8"	214' 2.8"	∞

DEPTH OF FIELD TABLE FOR CRITICAL PHOTOGRAPHIC WORK

Distance		7 ft.	10 ft.	15 ft.	20 ft.	30 ft.	50 ft.	100 ft.	200 ft.	Inf.
f/1.9	NEAR	7'	10'	15'	20'	29'11.9"	49'11.7"	99'10.7"	199' 6.6"	86341' 2.1"
	FAR	7'	10'	15'	20'	30' 0.1"	50' 0.3"	100' 1.3"	200' 5.4"	∞
f/2	NEAR	7'	10'	15'	20'	29'11.9"	49'11.7"	99'10.6"	199' 6.4"	82024' 3.3"
	FAR	7'	10'	15'	20'	30' 0.1"	50' 0.3"	100' 1.4"	200' 5.7"	∞
f/2.5	NEAR	7'	10'	15'	19'11.9"	29'11.9"	49'11.6"	99'10.3"	199' 4.9"	65620' 0.9"
	FAR	7'	10'	15'	20' 0.1"	30' 0.1"	50' 0.4"	100' 1.7"	200' 7.1"	∞
f/2.8	NEAR	7'	10'	15'	19'11.9"	29'11.9"	49'11.6"	99'10.1"	199' 4.1"	58589' 8.5"
	FAR	7'	10'	15'	20' 0.1"	30' 0.1"	50' 0.4"	100' 1.9"	200' 8"	∞
f/3.5	NEAR	7'	10'	15'	19'11.9"	29'11.8"	49'11.4"	99' 9.6"	199' 2.1"	46872' 5.1"
	FAR	7'	10'	15'	20' 0.1"	30' 0.2"	50' 0.6"	100' 2.4"	200' 9.9"	∞
f/4	NEAR	7'	10'	15'	19'11.9"	29'11.8"	49'11.4"	99' 9.3"	199' 0.7"	41013' 9.4"
	FAR	7'	10'	15'	20' 0.1"	30' 0.2"	50' 0.6"	100' 2.7"	200'11.4"	∞
f/5.6	NEAR	7'	10'	14'11.9"	19'11.9"	29'11.7"	49'11.1"	99' 8.2"	198' 8.3"	29296' 5.9"
	FAR	7'	10'	15' 0.1"	20' 0.1"	30' 0.3"	50' 0.9"	100' 3.8"	201' 4"	∞
f/6.3	NEAR	7'	10'	14'11.9"	19'11.9"	29'11.7"	49'11"	99' 7.7"	198' 6.3"	26041' 8.3"
	FAR	7'	10'	15' 0.1"	20' 0.1"	30' 0.3"	50' 1"	100' 4.3"	201' 6"	∞
f/8	NEAR	7'	10'	14'11.9"	19'11.8"	29'11.6"	49'10.7"	99' 6.6"	198' 1.6"	20508' 6.4"
	FAR	7'	10'	15' 0.1"	20' 0.2"	30' 0.4"	50' 1.3"	100' 5.5"	201'10.9"	∞
f/11	NEAR	7'	10'	14'11.9"	19'11.8"	29'11.4"	49'10.2"	99' 4.5"	197' 5.3"	14916' 2.3"
	FAR	7'	10'	15' 0.1"	20' 0.2"	30' 0.6"	50' 1.8"	100' 7.6"	202' 7.6"	∞
f/16	NEAR	7'	9'11.9"	14'11.8"	19'11.7"	29'11.2"	49' 9.5"	99' 1.2"	196' 3.6"	10255'10.9"
	FAR	7'	10' 0.1"	15' 0.2"	20' 0.3"	30' 0.8"	50' 2.6"	100'11.1"	203'10.2"	∞
f/22	NEAR	7'	9'11.9"	14'11.8"	19'11.6"	29'10.9"	49' 8.5"	98' 9.1"	194'11.3"	7459' 8.8"
	FAR	7'	10' 0.1"	15' 0.2"	20' 0.5"	30' 1.2"	50' 3.5"	101' 3.3"	205' 4"	∞
f/32	NEAR	7'	9'11.9"	14'11.7"	19'11.3"	29'10.3"	49' 6.9"	98' 2.5"	192' 8.8"	5129' 7.1"
	FAR	7'	10' 0.1"	15' 0.3"	20' 0.7"	30' 1.7"	50' 5.2"	101'10.3"	207'10.2"	∞
f/45	NEAR	7'	9'11.9"	14'11.5"	19'11.1"	29' 9.7"	49' 4.9"	97' 6"	189'11.1"	3648' 7.9"
	FAR	7' 0.1"	10' 0.1"	15' 0.5"	20' 0.9"	30' 2.4"	50' 7.3"	102' 7.6"	211' 2.7"	∞

HYZER ON HIGH SPEED

The method of synchronizing a high-speed camera with the event depends on both the camera and the event. This classification is Part I in solving the problem.—W. G. Hyzer

As the time interval for synchronizing high-speed camera with event gets too brief for human eye and hand, automatic synchronization becomes a practical necessity.

The limitations of human reflexes in high-speed photography were discussed in this column in the May 1961 issue; now I want to turn my attention to the intricacies of automatic synchronization. The first step, and the object of this column, is to develop a vocabulary to deal with the subject. Next month I want to go into the basic types of high-speed synchronization. Besides preparing for future this will serve as an overview of columns, which will analyze actual synchronization problems in detail, the high-speed field.

Framing cameras

Let's take up the matter of cameras first. I divide the high-speed framing cameras roughly into five categories. (Space does not permit a discussion of the non-framing or streak systems, which constitute a subject in themselves.)

Class A—Single exposure, single frame—a conventional still camera with some means of making a short exposure. The means may be a fast, built-in or auxiliary mechanical shutter, an inertialess auxiliary shutter such as a Kerr cell, or an electronic flash or spark gap used "open flash."

Class B—Multiple exposure, single frame—again a conventional still camera, however in this case it is equipped with a repetitive mechanical shutter or "light chopper," a repetitive electronic flash unit, or a flashing light attached to the subject.

Class C—Continuous writing, multiple framing—at this juncture we move from the still camera field to the sequential camera field. The difference is that the camera makes a number of discrete photographs on a length of film, thus the "multiple framing." The optical-mechanical arrangement of the camera is such that the frames are exposed to whatever is in front of the lens in a cycle that repeats and repeats as long as the camera is in operation, thus the "continuous writing." Generally, such a camera is used with an electronic flash unit, whose duration is less than the time it takes the camera to complete a cycle. The result is a short length of film with a series of sequential images, each exposed during a small fraction of the electronic flash discharge, but together covering the span of time of the flash.

These "always alert" sequential imaging cameras (which operate in a cyclic mode, characteristically of the rotating drum type) are exemplified by the Beckman & Whitley Dynaflex and Frungel Strobodrum. Also in this category is the Beckman & Whitley Model 192, which utilizes a spinning, triangular-shaped mirror to transpose the image on a stationary arc of film.

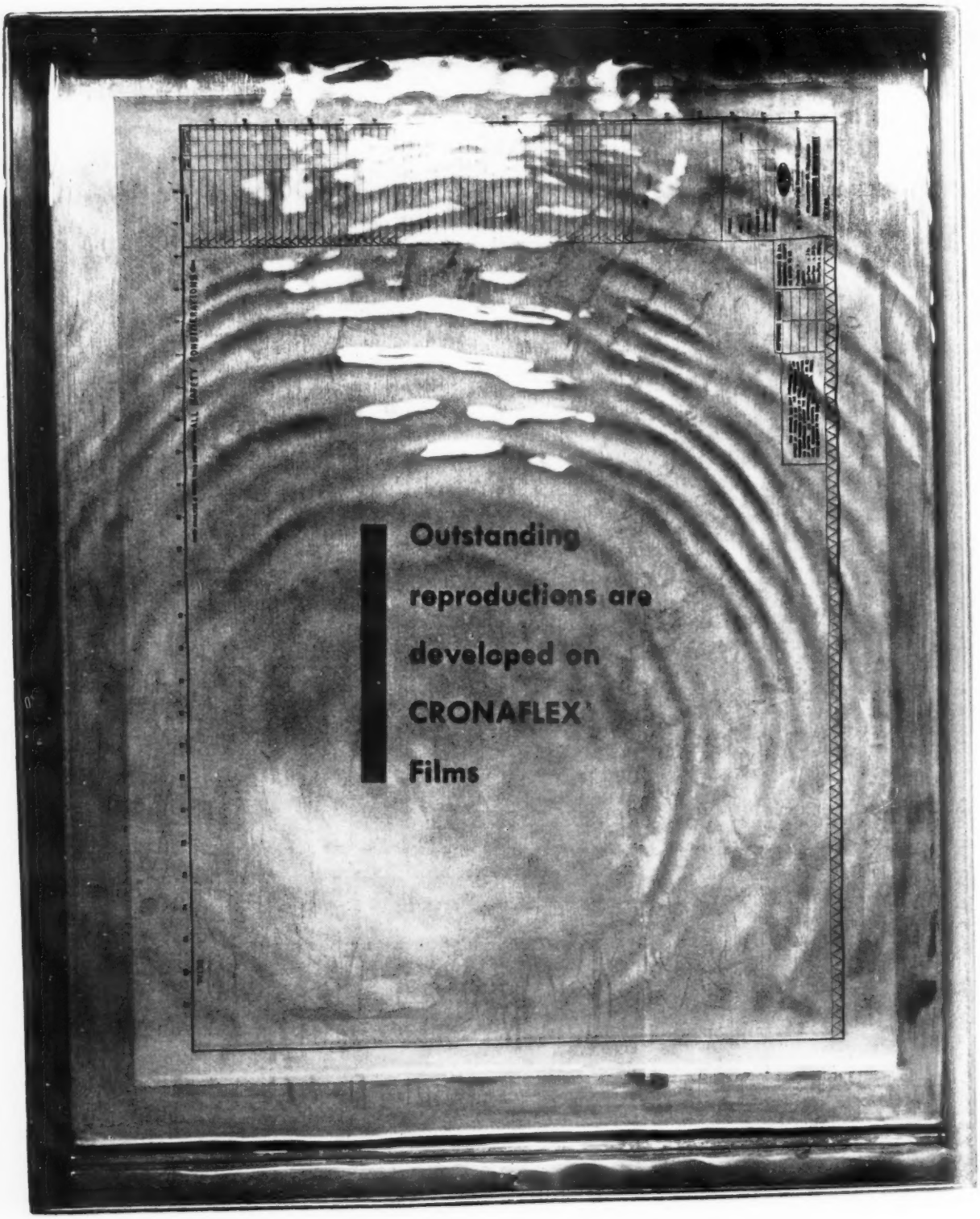
Class D — Transitory-writing, multiple framing—most of the high-speed cine cameras fall into this category. On command, they record a finite series of frames throughout a single, finite interval of time. Examples are the Fairchild Motion Analysis camera, the Fastax and the Magnifax.

Certain image-dissecting cameras which achieve their high speeds y dissecting the image and

(continued on page 86)

FRAMING CAMERAS	EVENT CLASSIFICATION				
	Type I Continual	Type II Controlled	Type III Repetitive	Type IV Announced	Type V Spontaneous
Class A Single-exposure, single-frame	A	B	CE	CE	C
Class B Multiple-exposure, single-frame	A	B	CDE	CE	C
Class C Continuous-writing, multiple-framing	A	B	CDE	CE	C
Class D Transitory-writing, multiple-framing	A	B	DE	E	Impossible
Class E Intermittent-writing, multiple-framing	A	B	DF	Impossible	Impossible

Table 1 Synchronization Criteria A) No synchronization required **B)** Synchronization readily achieved **C)** Event may be recorded if the beginning of the action can be sensed instantaneously and followed up immediately by the initiation of a rapid-acting shutter or light source **D)** Event may be recorded if period between successive recurrences is substantially less than the camera writing time **E)** Event may be recorded if the beginning of the action can be anticipated by a time interval exceeding the camera starting transient **F)** Event may be recorded if the camera writing period can be cycled in synchronism with occurrence of the action. **Note:** Degree of shading indicates increasing complexity of problems involved in synchronizing camera and event.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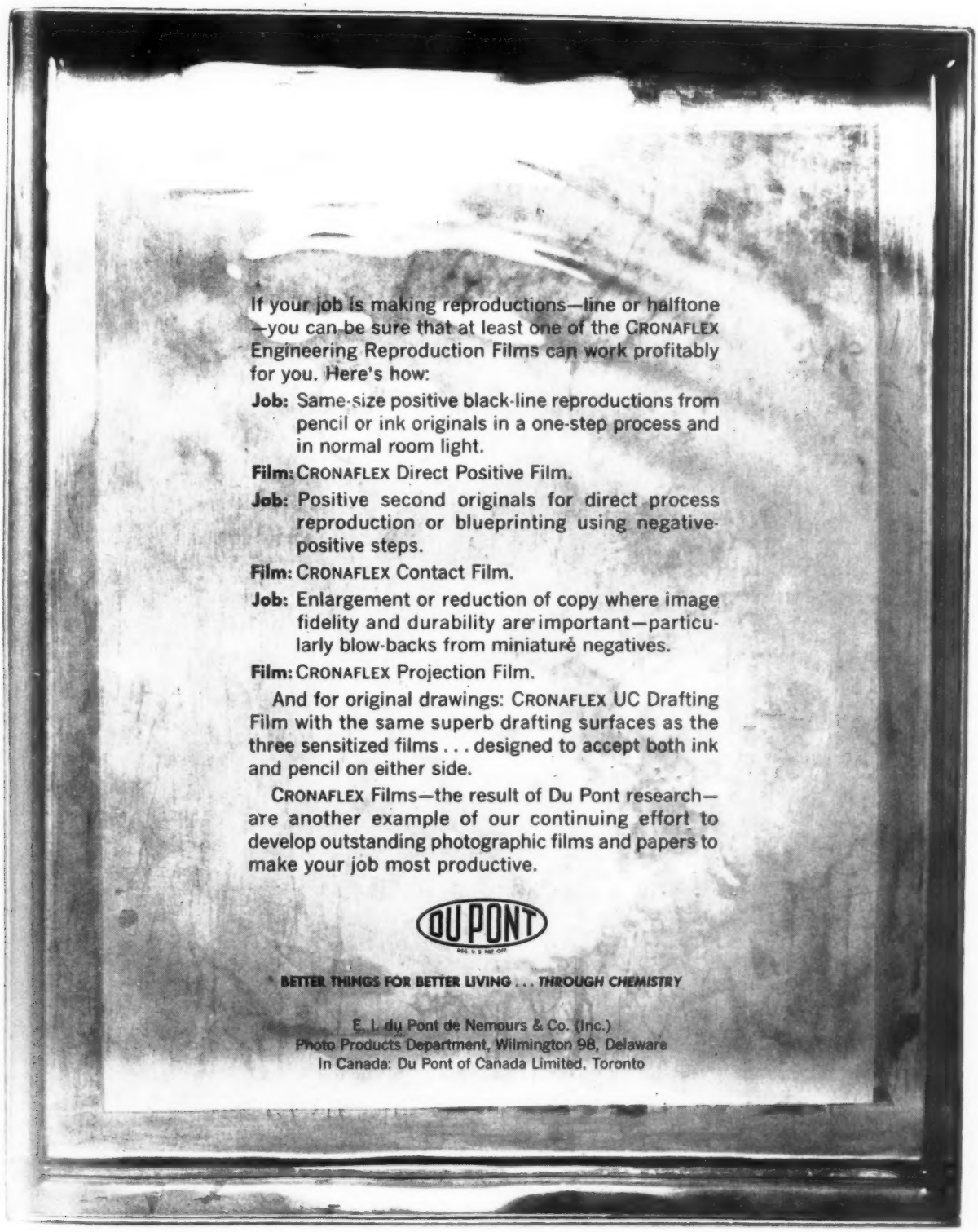
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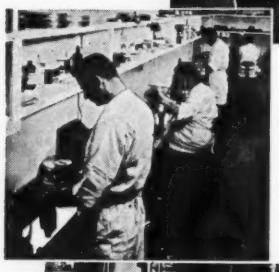

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CUTTING

Everything's at hand in this "home made" editing desk used at Nationwide Insurance—*Nils Lindquist*

The following article is offered in response to requests for more information about the editing desk, designed by Nils Lindquist of Nationwide Insurance, mentioned in our Photo Department Analysis of that photo group (see *PMI*, Feb. 1961, page 42)—Ed.

There are as many varieties of editing desks as there are editors to use them. Each editor equips and organizes his desk to suit his own peculiar working habits.

The desk described in this article is a composite of ideas taken from many editing desks. With equipment, it furnishes complete editing facilities using 30 x 60 inches of floor space. The editing equipment and supplies are located either on the table or easily accessible on the open shelves. The drawers contain the film to be edited and a pull-out shelf is provided for scripts.

Work flows from left to right over a built-in viewer. With these facilities any editor can make film ready for the laboratory printers.

Work plan

A typical editing job such as matching A & B original film to a workprint would go as follows: The workprint would be placed on the left rewind through the synchronizer onto the right rewind. Next, the workprint edgenumbering would be checked and the original reel containing this scene pulled from the drawer and placed on the small rewinds. The desired scene would be located, cut and spliced into the A or B roll in synch with the workprint.

Part of the equipment for this desk was "homemade." The built-in viewer is a hinged metal box lined with two foot-long showcase light bulbs connected to a switch and covered with ¼-inch ground glass. The leader supply spools are made from plastic reels and a ¼-inch metal rod. The Ediola viewer was altered by the addition of a magnetic head built into the base by the Land Specialties Company of Kansas City, Mo.

The desk is located in a regular office with a switch provided to turn off the ceiling lights. The only additional furniture used with the desk is a rectangular editing bin and a chair.

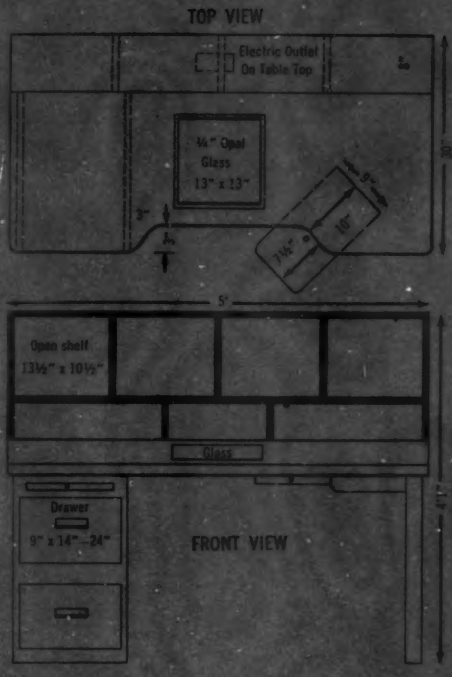
Happy editing

Many hours of work are spent editing before raw footage becomes a movie and the more adequate the working conditions are the better the movie will be. A good editing desk makes cutting out one's favorite scene almost a pleasant job.—THE END

Equipment & Supplies

Set of gang rewinds ■ Set of small rewinds ■ Action viewer ■ Light box viewer ■ Four gang synchronizer ■ Optical and magnetic sound reader ■ Hot splicer ■ Table lamp ■ Core dispenser ■ 3/8 in. drafting tape dispenser ■ Film rack ■ Leader supply rod ■ Such supplies as: leader • pen • pencils • ink • punch • scissors • cement • tape • gloves

BOON



Plans for editing desk were turned over to company carpenter by author Lindquist. Lumber required: ¾ in. plywood (two 4 x 8 in. sheets) or ¾ in. white pine and 3 x 3 in. table leg.

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Get more information. Circle 410, page 91

Ernest E. Reshovsky

PHOTO INSTRUMENTATION

They've finally done it: TV for viewing B&W negatives positive

Every so often you run across a new device of great potential value, based on such long known principles that you wonder why nobody had thought of it before.

Such was the case when an English electronics engineer, Brian Hooper, now living in North Hollywood, showed us his Nega-Viewer. It looks deceptively like a standard 17-inch TV set, yet its functions are to electronically reverse a photographic negative so that it can be viewed instantly on the screen as a 17-inch positive.

The film is inserted in a carrier on top of the set and appears on the screen either as a positive or, at the flip of a switch, as a negative.

This makes it possible to preview and pre-edit enlargements, without the need for proofing, and at a great saving in time. The Nega-Viewer contains a TV film flying-spot scanner, an optical bench, an amplifier with phase-reversing switch, and a standard 17 inch TV viewing tube.

The film is scanned by a spot of light on the face of a 5-in. cathode ray tube tracing a TV-like raster approximately 3 x 4-in. This flying spot raster is then focused by a short focal length lens onto the film (either a negative or a positive) and the light passing through the film at any one instant is picked up by a multiplier type phototube. The tube gives out a signal proportional to the amount of light transmitted through the film at each position of the spot. This signal is then passed through the positive/negative phase reversal switch. After amplification it is applied to the viewing TV tube as a spot in the same relative position as the scanning spot. The brightness is proportional to the transparency of the film at that point. In each period of 1/60 sec. the film is completely scanned, line by line, from top to bottom. The light intensity that can pass through the negative at each point is usually reproduced on the viewing tube 180 degrees out of phase to result in a positive image.

Since the energy used to sweep the scanning tube is also used to sweep the spot of light on the viewing tube in direct synchronism, there are no "horizontal hold" or "vertical hold" controls on the unit. The Nega-Viewer has only four controls and two switches on the side for adjustment: the normal contrast and brightness controls to adjust for high or low contrast negatives, a mechanical focus control, a "line control" to give the most pleasing viewing raster, an on-off switch and the positive/negative switch. For vertically framed negatives a knob is pulled which turns the scanning raster 180 degrees and thus erects the picture on the viewing tube.

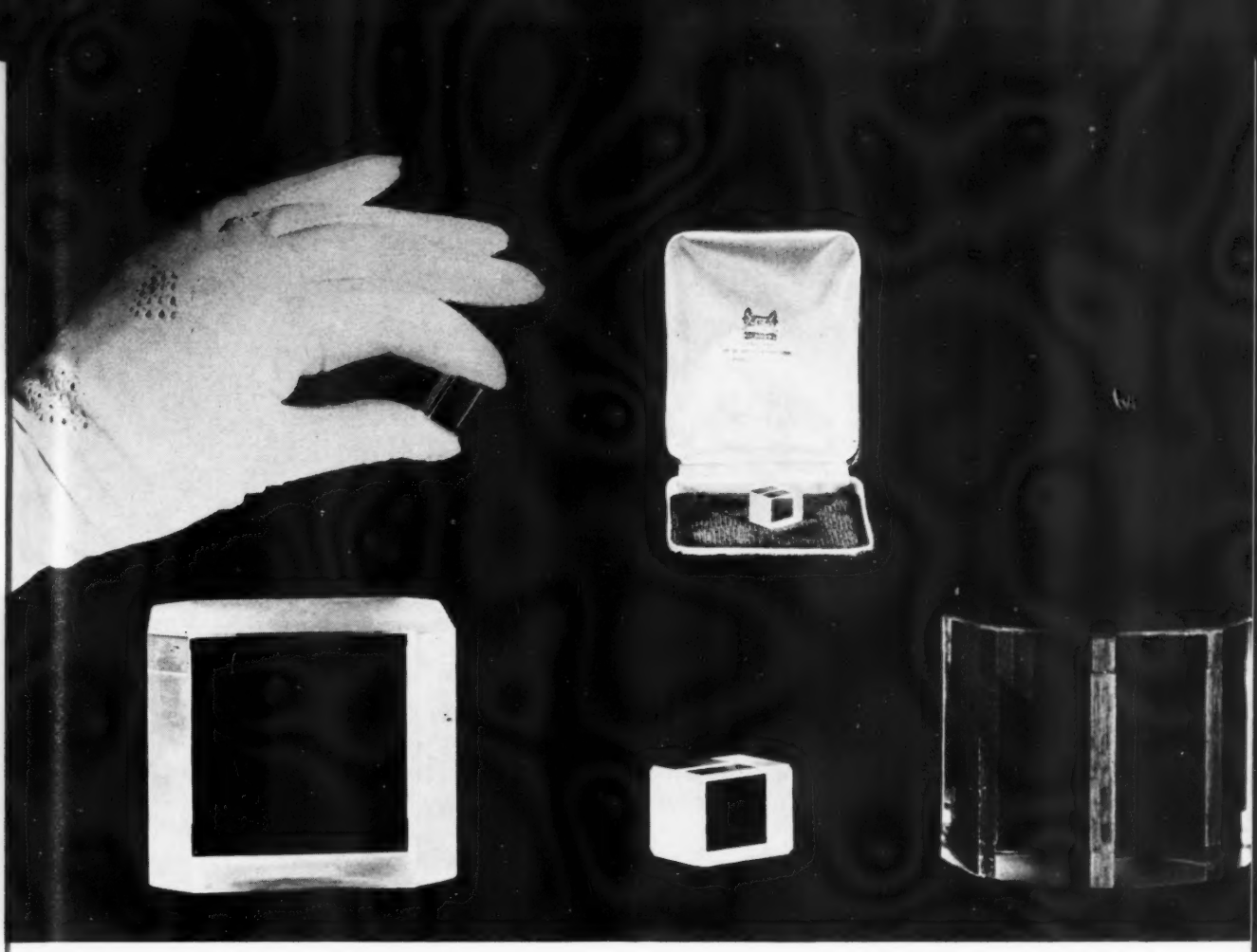
There is also an enlargement control at the rear which varies the enlargement from a full frame for closer examination in greater detail.

Hooper talked of his future plans: He intends to make a motion picture version of the Nega-Viewer, which could be used as a table viewer for positive motion picture film or as a previewer for motion picture negatives.

Further plans in the more distant future call for a color version of the device to preview color negatives as color positives. A patent was recently granted to Hazeltine inventors for a system which uses video circuitry to display a color negative as a color positive for predicting balance of color printing lamps. *(See* PMI, *December 1960, P. 47, "A Dream Money Buys.")*—THE END

PMI Goes to Bed Early

So mail early to get your news in FYI and Coming Up. Right now you should be sending items for November and December, 1961.



THE FAMILY JEWELS

The Photo-Sonics 16mm-1B camera takes 1,000 clear, sharp pictures per second, using the optical prism shown here in jewel case and gloved hand. Here, also, are some of the prisms used by the 16mm-1B's distinguished big brothers.

The prism in the center gives 3,000 full-frame 35mm pictures per second. The king-sized chunks of glass on either side provide 360 full-frame or 720 half-frame 70mm pictures per second. There's another 16mm camera operating at 4,000 frames per second. It's quite a family!

The junior member of this clan, the 16mm-1B, is a bargain at $1,660 complete with 100-foot magazine and 1-inch ruggedized lens. It gives a speed range from 12 to 1,000 frames per second; 100, 200, 400 and 1,200-foot magazines; and a full assortment of lenses from 165° wide angle to 24-inch focal length. It's an amazingly versatile camera.

There's one more added dividend. All of these fine instruments have disc shutters behind the prisms to give resolution and motion-stopping performance like you've never seen before.

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Get more information. Circle 496, page 91

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McDONNELL AIRCRAFT
(continued from page 44)

first development time from the recommended 14 to 17 minutes. There was no appreciable loss of quality.

An 85C filter is always used with Type S film. The filter is taped behind the lens (on the rear of the lensboard) so that it is always in place. The filter density is not great enough to affect black-and-white exposures to any serious extent, so that both color and black-and-white are shot using the same camera. If any corrections are necessary, they can be made in printing.

Generalists all

At McDonnell, work assignments depend largely upon the degree of skill and adaptability of the man involved. There are no specialists as such, although some men develop outstanding abilities in one particular area (such as movie photography) which brings them a large number of assignments within their special field. Generally, however, a photographer is expected to be able to supply still and movie and printing if necessary. Color coverage and handle processing processing, however, is done by specialists.

One of the color specialists is Jack Murphy who processes color prints. He is considered one of the best in the business, a not unusual accolade except for one thing. Murphy is blind. He was blinded in an accident. Despite this, he was able to learn lab procedure and more than hold his own in terms of productivity and quality.

McDonnell is a firm believer in on-the-job training. In looking for new people, preference is given to an enthusiastic amateur rather than a professional from another firm. According to Schmidt, the amateur has less to "unlearn" and he gets used to doing things according to section procedure.

"Our way may not necessarily be the best way," continued Schmidt, "but we've found that it gives us consistent results and efficient operation."

There is virtually no turn-over and promotions are made from within the section. No one has ever been fired for poor performance. If

(continued on page 76)

PROFESSIONAL-INDUSTRIAL NEWS FROM CORMAC UNIBATH

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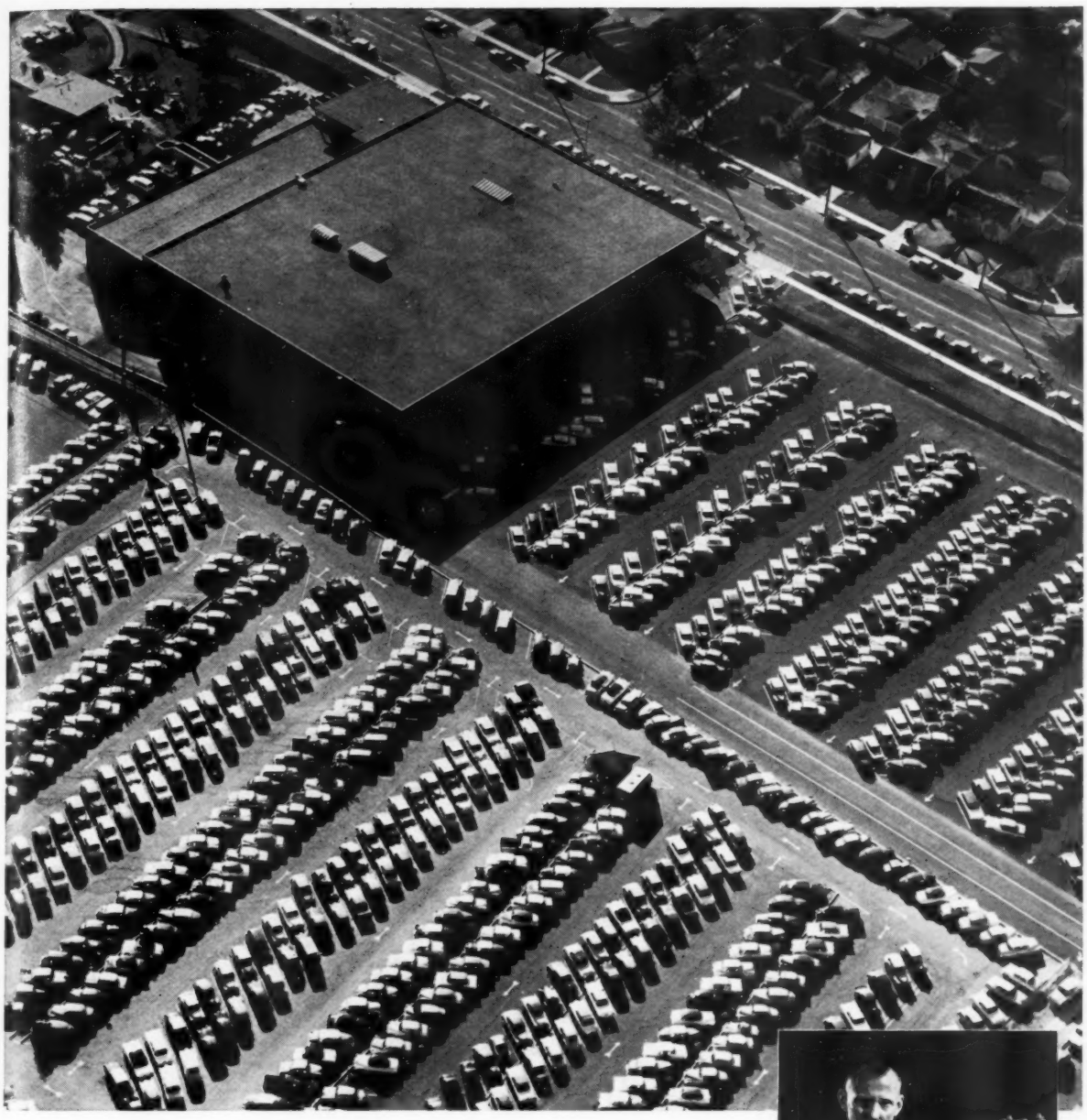

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KENNETH H. HOUGEN, Photo Department Supervisor, Consolidated Electrodynamics Corporation, Pasadena, Calif.

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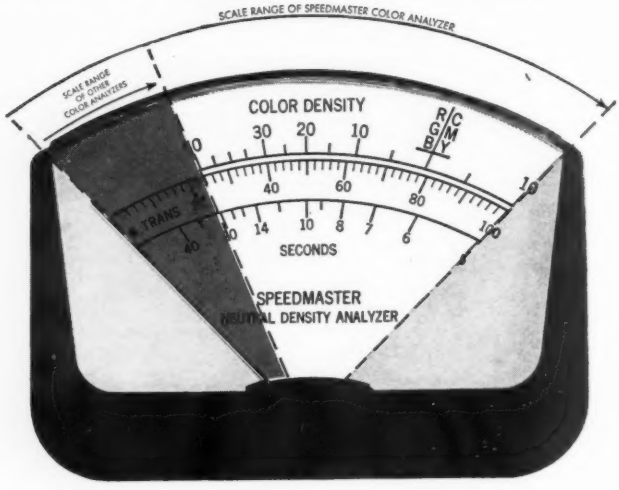

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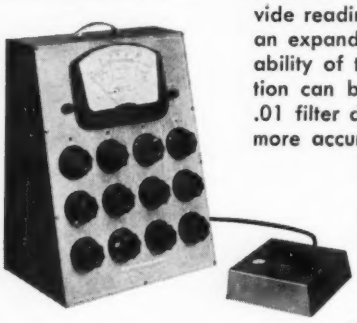

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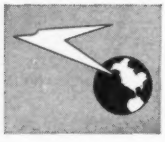

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McDONNELL AIRCRAFT

(continued from page 74)

a photographer's pictures show a sudden drop in quality, Turk or Schmidt will take him aside to work with him. In some cases, the drop is due to a recently-developed habit which spoils the picture, such as jerking on a body release instead of squeezing gently.

Jack be quick

In other cases, there may be a basic defect which must be considered when assignments are made. A current case involves color coverage of flight tests. The photographer should time his exposure so as to get as large an image as possible on his negative. This means that the exposure must be made when the aircraft is at a particular spot. Shooting too soon will give merely a speck on the 4 x 5 negative. Shooting too late will result in part of the plane being cut off. Some cameramen handle this job perfectly while others show consistently poor timing.

This means that certain men may not be assigned to test shots but may do other work where split-second timing is less important. Occasionally, a group of photographers will load their Graphics with Polaroid film and go out on practice assignments. They can tell almost immediately whether or not their timing was "on".

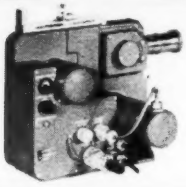
Test photographs are an important part of the photographic workload. Coverage is planned at an early stage in test planning to ensure enough men and material for complete coverage, for public relations, for the contracting service, for sub-contractors and for engineering and company records.

Two or three days before the flight, Turk or Schmidt will confer with Flight Test to see what their requirements might be, with other departments who may need photo reports and with Flight Safety to plan the photo operation.

It is important, for example, that cameramen be able to record point of lift-off, angle of attack, operation of control surfaces, etc. During an operation, there may be a half dozen photographers, both still and movie, lined up along the take-off path.

If expected lift-off is at the 3000-foot point on the runway, a man will be stationed at the 2800-foot point and at 200-foot intervals for, perhaps, another thousand feet. Test pictures are shot in color

(continued on page 78)

1 

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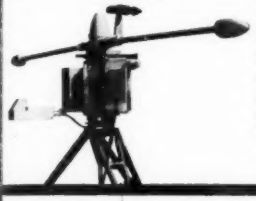
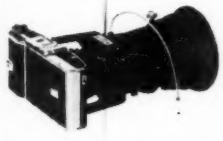
3 

Photographic Flight Analyzer records flight data as a self-plotted photographic chart. Trajectories, takeoff and landing characteristics, verticals, horizontals, angles. Timing is measurable to .0005 seconds.

4 

F286 & F296 Oscilloscope Camera with Polaroid® back. Gives permanent records in 2 to 10 seconds. Full size or half size prints.

5

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6

HS101 Camera shown with HS504-C1 Top Speed motor kit. Drives at 8,000 pps. Magnetic braking and drag adjustment. Controls in separate miniature package.

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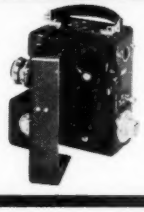
8 

Fairchild-Siemens Recording Camera. Cine 24fps. Stills at 8 per sec. to 1 per 24 hours. Shutter 1/30th to 1/150th second. Automatic or manual shutter.

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For complete technical data and prices of these products, we suggest that you check the information service form and mail it to us. Your request will be filled by return mail.

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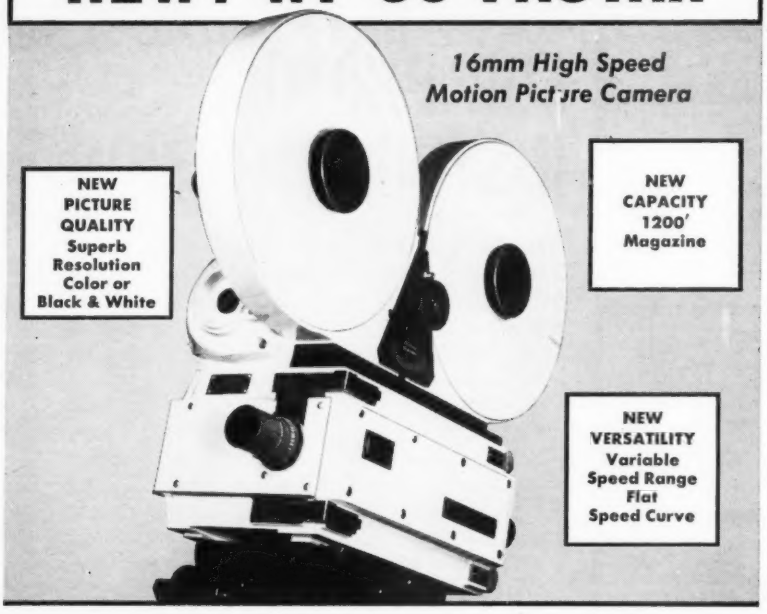

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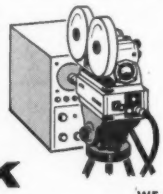

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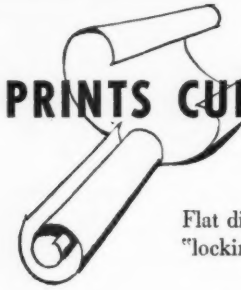

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McDONNELL AIRCRAFT

(continued from page 76)

routinely, using normal lenses. Long focus lenses are not used as they have too narrow a viewing angle and they tend to magnify any vibration.

About 90 per cent of still photography in the department is handled by the 4 x 5 Graphic. While cameras are not assigned permanently, each photographer uses the same camera as long as practical. The feeling at McDonnell is that smaller negative sizes, particularly 35mm, are too small to provide consistent top-quality enlargements without a great deal of extra effort.

A Rolleiflex with f/3.5 Tessar is sometimes used for movie location shots and for available-light work around the plant. Schmidt reports excellent results using Royal-X Pan rated at 1250 developed in DK-50.

There is little liklihood of any desertion from the 4 x 5 ranks. "The Graphics have been used for virtually every type of picture and have proved quite adequate," stated Schmidt.

Films used include Verichrome Pan and Tri-X. Royal Pan and Commerical and, for color, Ektacolor, Types S and L, and Type B Ektachrome. Black-and-white film is processed either in DK-50 or D-76, depending upon the degree of enlargement needed. Color is processed according to manufacturer's instructions except when pushed.

Sheet film negatives are developed in 3½ gallon tanks. Up to 40 sheets of 4 x 5 can be handled at any one time. Developing may be done either by the photographer or by a lab man.

Printing is done using Omega D2 or Beseler enlargers. Standard paper is Polycontrast for enlarging, with Azo being used for contact work. Exposures are timed with Time-O-Lite timers. These timers are operated from an extension button placed at the edge of the enlarging table, thus eliminating waste motion and possible accidents if the operator had to lean across the table to press the button on the timer itself.

The 4 x 5 negative file is in the main lab, in steel file cabinets. Both black-and-white and color negatives are filed, but not together. Negatives are listed numerically (there are over 235,000 negatives in the file now) by date, title or, in the case of test shots, model number.

(continued on page 80)

A studio in a travel case—only Hasselblad has it!

One camera—a Hasselblad 500C—is all you need ever carry. It sets up in seconds for everything from micro to telephoto work. The secret? The system—the Hasselblad system of interchangeable lenses (covering 9° to 90°), film backs and accessories. And the case carries all.

For your work, change to any one of 6 Zeiss lenses, each with an automatic preset diaphragm in its Compur shutter, synchronized for flash and strobe at all speeds (1 sec. to 1/500). Each with automatic depth-of-field indicators. Cross coupling and EVS system too. Switch viewfinders and film backs. (Change from b-and-w to color in mid roll.) And switch as you like between negative sizes and a host of other accessories. Isn't it time you started building your studio in a travel case? Write Dept. HPM-9 for the name of the nearest dealer. Paillard Inc., 100 Sixth Avenue, N.Y.

Accessories shown include: 60mm, 150mm (on camera), 250mm Zeiss lenses; Super-Wide C Camera, extra backs, bellows extension, magnifying hood, sports finders, micro-adapter, extension tubes, rapid crank, filters. New Pentaprism available soon. Hasselblad 500C with 80mm lens $549.50.

HASSELBLAD

Get more information. Circle 473, page 91

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McDONNELL AIRCRAFT

(continued from page 78)

The section is currently breaking down the negative data into digital form suitable for use with IBM cards. However, the card-sort system has not yet been adopted so after the digital information is recorded, the negative goes into the file with all the others pending final adoption of the new system.

Incidentally, one of the minor objections to the use of 35mm is that having to file negatives in strips of four or six would not fit in with the current single negative system of filing. About 90 per cent of the negatives are 4 x 5.

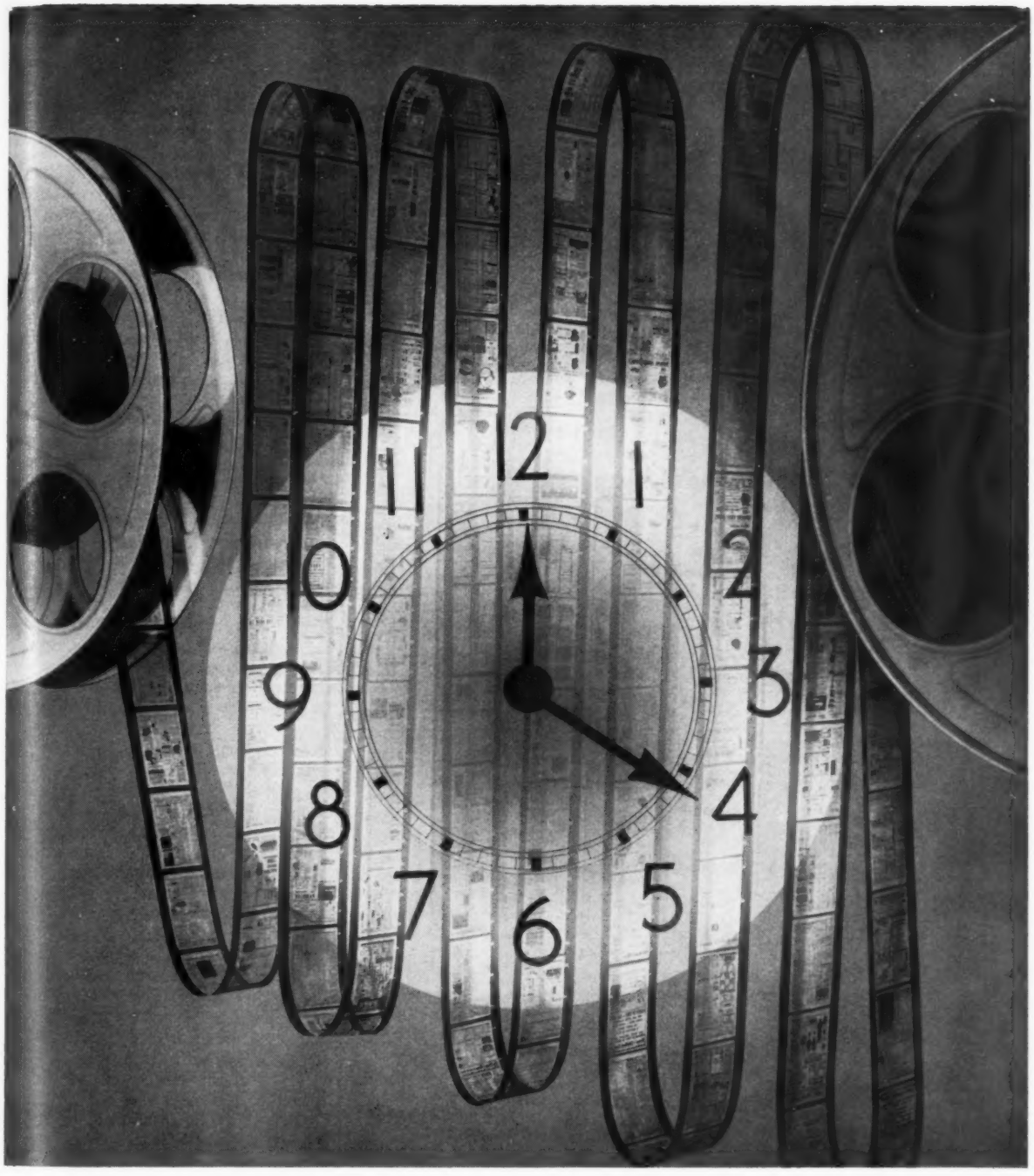
Why buy if you can make?

There are over 750,000 feet of film in McDonnell's stock footage file. Stored on 400-foot reels, each reel is kept in a plastic bag which affords adequate protection against dust and dirt. The air-conditioning provides the necessary control of humidity. Here, as in every other phase of the photo operation, there is no waste and few frills.

The fiberglass developing tanks, for example, were built in the plant at about 1/4 or 1/5 the cost of similar units made of stainless steel and bought on the outside. Every attempt is made to keep capital expenditures to a minimum. Photo equipment is not depreciated but used until it is no longer serviceable. To avoid excessive requests for equipment, in-plant built items are designed and used wherever possible.

For non-caiptal items (sensitized materials, minor equipment, etc.), a system of "Buy-Outs" is used. Open orders for a given amount (in dollars) of supplies are placed with several industrial dealers in the St. Louis area. When film is needed, for example, the section will get a bid to secure the lowest price, then place the order and charge the cost against the "Buy-Out."

A minimum inventory is kept on hand, the stock level varying inversely with the speed of delivery. Motion picture film is, perhaps, the most critical item, since great quantities are used for tests and test schedules do not always coincide with delivery schedules. Generally, about 15,000 to 20,000 feet of Commercial and High-Speed Ektachrome is kept on hand in 100, 200 and 400-foot rolls. About 12,000 feet of black and white film in the same sizes (about 4,000 feet in each size) is also stocked.—THE END



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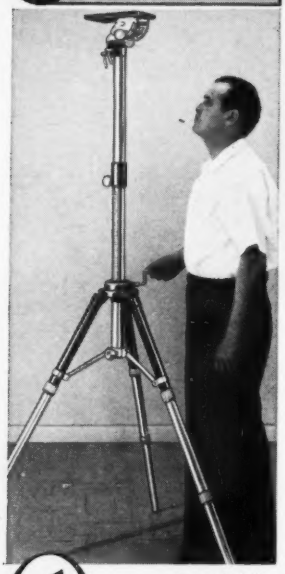

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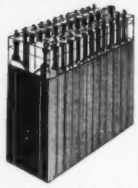

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THUMBNAILS

(continued from page 45)

The story board artist, to be effective, must be more than a skillful artist. He knows what the camera can do and how a film editor can synthesize the fragments that are shot. When image follows image, the result is, quite often, greater than the sum of its parts. It may be an entirely new image.

A technical advisor working on a film once said "there would be no communication probems if we coud use formulas and equations." But try to describe water as H_2O.

Water is more than merely the sum of hydrogen and oxygen. We must not be content to study one and then feel we know about two because it is merely one *and* one. We must also study the *and*.

The sum and "its" parts

The importance of the story board is that it does study the *and* factor with sometimes unpredictable results. It is something like communicating with ideograms. In Chinese, for example, the sun and the moon are represented together in one character. The resulting meaning is not "sun plus moon" but "brilliance," a new character. Nothing can shine as brightly as the two together.

These observations may seem remote to problems of film making but consider our problem: we are handed a series of cards which sum up a system conceived by a bright young scientist, solved in the minds of bright young computers, and told "make a film of this."

Where do you start? You have to start with a picture which will simplify the complex, illuminate the obscure and hold the attention of an indifferent audience.

Let us, at this point, look at some of the uses of a story board.

First, it clarifies the ideas of the technical adviser. It is common that a man, even an expert in his field, may be unaware of the implications of his words until they are turned into pictures.

Second, it clarifies the picture's ideas for the client. This is true for the client who can't read, who is too busy to read, who prefers pictures to words or who is too astute to trust words.

Third, it tests films before production. This use of the storyboard has been neglected. Story boards, synchronized for sound and shot

(continued on page 84)

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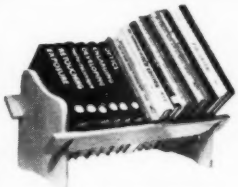

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THUMBNAILS

(continued from page 82)

for motion picture projection, were exhaustively tested before production was allowed to start. The test audiences were typical of the groups for whom the film was planned. The response and results were sometimes very surprising.

Fourth, it explores the structure of the film. It shows the way details are organized, the relationship of scene to scene, scene to sequence, motion to rest. It involves what is directly presented and what is suggested. It points up the factors which increase or decrease visual intensity.

Story boards use the construction of the shot, the light and dark pattern, the details of the set or location, postures of the actors, all the factors which go into a visual rendering of the story. They save time, the expense of shooting and processing test footage and the general human wear and tear involved with wasted effort.

Remember, however, that the story board is not the final statement of the film. It is merely a means, and not the only means, to an end.

(This article was adapted from a talk given before the Industry Film Producers Association by Mr. Novros of Graphic Films in March 1960.–Ed.)

FYI

(continued from page 9)

the use of photographs in ASTM.

For those who keep a "don't miss" calendar, we suggest that an entry be made for the 5th Annual Industrial Film and A-V Exhibition, October 9 to 11 at New York's Barbizon-Plaza Hotel. Among the topics to be discussed: Filmstrips as a Means of A-V Communication in Sales Training; Animation; Professional Film-Handling Workshop, and, The XYZ's of Film Distribution.

While this may seem slightly removed from hypo and film holders, there are always ideas on the use of photography which a wise in-plant man can keep for propitious moments, such as when the VP in charge of everything wants to know about setting up a program.

In addition to information, prizes will be awarded to the best industrial films and TV commercials. So, whether you are broadening your horizons or whether you want to see New York as an autumn festival, keep the Exhibit in mind.

WORKING PHOTOGRAPHER

(continued from page 6)

control over what employees did on their time off and he has had employees who have run businesses on the side. However, he added, if a man is running a wedding business and wants to do it on his own time, o.k., but if we need him to go out of town to cover a ship launching, he had better be working *primarily* for us.

Moonlight and politics

Cliff Pareis added that they encouraged photographers to experiment and do a reasonable amount of shooting, but when a man did an extensive bit of it, the *department* saw that the company was reimbursed for materials used. Because of safety, watchmen, etc., however they tried to avoid anyone working overtime or after hours. Personal work is done when company work is finished. Someone asked was it finished in time? Pareis said that when there was personal work to be done, you'd be surprised how fast company work can get done—and without remakes, too! And then he added that whenever there was a big work load to get out in a hurry, he found the best thing to do was to go into the darkroom in the morning and start a political argument. Then they stopped talking and really worked!

Competition

Parkelee from Westinghouse asked what the feeling was about the use of amateur cameras and Polaroid cameras by employees who make pictures. I stuck my neck out by commenting that I was a strong believer in box-cameras for truck drivers and amateur cameras for engineers. However, I added, I also think there *must* be a trained photographer behind every camera. Maybe not *right* behind it, but directing it, surely.

Orlin Donaldson added that during the war there were restrictions on cameras in plants, but now that everyone made pictures, this was a company policy to decide. However, now they show engineers and other qualified people how to make pictures and constantly call attention to how much time and material is wasted by non-professional picture making. Parkelee added that they also pointed out goofs and time wasting by amateurs with improper training or equipment, although always glad to train non-professionals. He also said that when the amateur in management wanted to show off his personal pictures, it's a smart stunt to point out the difference between a snapshot and a professional industrial shot.

Lisle Morseman of Shell Development Co. said that they controlled everyone behind a camera because all cameras used on projects were owned by the photo department which had a supply of equipment of varying complexity, and would buy any special piece really needed. The argument for this is that they purchase the cameras so that they can be reassigned and used for future projects after the original project is completed. Cliff Pareis added that the insurance business had many writers who traveled and used cameras, but that the areas where non-pros can work are limited, and inasmuch as cameras, materials, and processing is supplied by his department, only those who have passed his test in photography can qualify. This controls and raises the standards at the same time.

Bedside companion

Other subjects covered had to do with photographers taking company cameras home at night (most places wanted to have photographers equipped at all times, especially since they worked with emergency crews). Most agreed that they liked to avoid competition with local photographers and gave out excess assignments when possible to gain community relations and outside contacts they could rely on. Most agreed that getting new equipment was difficult but tried to avoid having photographers use personal equipment unless emergency required it. Several spoke of paying rental or covering personal equipment with insurance not only as a gesture but to call management's attention to need for more and better tools.

I think you can see how much one can pick up from just listening in on round-tables. The problems that you have are probably similar to the problems of others, but learning how other people cope, handle, or solve their problems may give you more sleep at night. It's a pleasure to find people in the communications business (industrial photographers) who are willing to communicate with each other.

91

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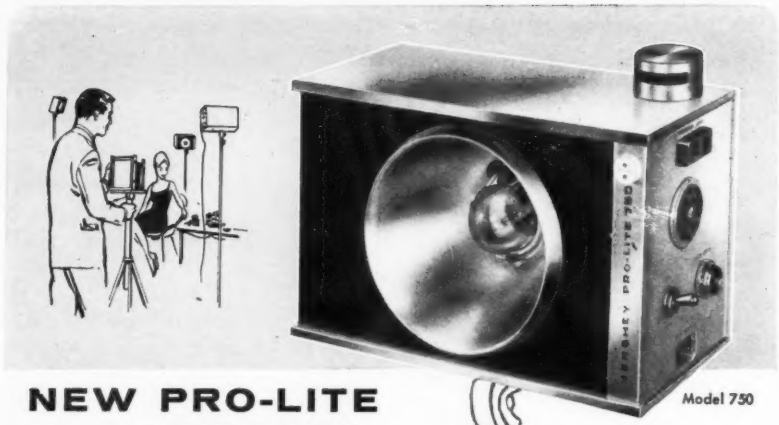

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Get more information. Circle 486, page 91

HYZER ON HIGH SPEED

(continued from page 67)

planting it throughout a single sheet of film, then move a short distance for the next image, might be considered a cross-breed of Class B and Class D. The Courtney-Pratt Series 600 is a good example.

Class E — Intermittent-writing, multiple framing—in this system, the camera mechanism is sequential and cyclical, like the continuous writing cameras. The difference is that the camera is alternatively alert, capable of recording an image, and alternatively blind. Characteristically these cycles are achieved through the use of a flat mirror which places a series of discrete images on a stationary arc of film, then turns over for the "blind" phase. Examples are the Beckman & Whitley Model 189, and the Barr & Stroud Model CP5.

High Speed events

Similarly, events which high-speed photography is called upon to record may be classified. I divide them into five broad categories with a few subdivisions.

Type I, Continuous. An event which proceeds as an uninterrupted activity. As far as the synchronization problem is concerned, this is applesauce. Examples are air flowing past a test specimen in a wind tunnel or the rotation of a flywheel.

Type II, Controlled. An event that may be initiated on demand, and which responds in an orderly, reliable manner, exemplified by an electrically detonated explosive reaction, the operation of electric solenoid or relay, etc.

Type III, Repetitive. An event that recurs at intervals. There are two types, periodic and irregular.

A repetitive event of the periodic type might be said to have *programmed intermittency* in that by nature it recurs at predetermined intervals. Examples are the firing of an internal combustion engine, or the recoil of an automatic machine gun.

A repetitive event of the irregular type may be *random* or nearly so. An example would be the formation of cavitation bubbles on a ship's propeller.

Type IV, Announced. An event that signals its forthcoming occurrence. Two examples of these signals are the leader stroke of lightning that precedes the main discharge and the rapid increase

(continued on page 105)

FREE LITERATURE

For your copy of any free literature item, circle the appropriate number on the reader's service card, which is attached, on page 91.

AUDIO-VISUAL

VISUAL COMMUNICATION 201
Charles Mayer Studios, Inc. 8-page brochure and price list describing the Hook N' Loop Board—presentation boards—a new dimension in visual communications. Gives complete detailed specifications.

KOOLITE 202
Buhl Optical Co. 6-page illustrated brochure entitled "To Teach, Train, Tell, Sell." Describes the Buhl Koolite Model 7000 overhead transparency projector, used in teaching, training, and selling. Gives specifications, accessories, and supplies.

SPLICING TAPES 203
Hudson Photographic Industries, Inc. Description sheet for Quik Splice T816M Splicing Tapes—claimed by Hudson to be approved and recommended by all sound stripping labs and sound projector manufacturers. Sheet describes advantages of Quik Splice.

FUJICA ATTACHE 204
Fuji Photo Optical Products, Inc. Description sheet for the Fujica Attache portable slide projector with built-in screen. Illustrates the many uses of this item, gives specifications, and lists some satisfied users.

MAGNAMATIC 205
Amplifier Corporation of America. Illustrated description sheet for the Magnamatic Sound-Slide Projector.

AUDIO-VISUAL EQUIPMENT 206
DuKane Corporation. 7-page booklet describes the DuKane line of audio-visual equipment. Includes the "Flip-Top", "Micromatic", and "Mite-E-Lite" sound slidefilm projectors.

CAMERA & LENS

DATA AND PRICE LIST 207
Zoomar, Inc. Comparative data and price list for the Zoomar Reflectar. Lists focal length, optical data, horizontal field angles, mechanical data, prices of lenses and accessories in chart form. Contains an illustrated analysis of its parts.

DUAL LENS CAMERA 209
Regiscope Corp. of America. 6-page illustrated brochure describes the Regiscope Electra Dual Lens Camera. This camera is claimed to give a film record of a person and document simultaneously—electronically.

HIGH SPEED CAMERAS 210
Camera Equipment Co., Inc. 4-page booklet describing John H. Waddell's high speed motion picture camera. Contains three characteristic speed curves and full features of this 16mm camera. Lists accessories.

MINOLTA SR-3 211
Minolta Cameras. 8-page illustrated folder describing the Minolta SR-3 35mm single lens reflex camera. Gives outstanding characteristics and main features. Describes the Minolta SR meter and remote control equipment. Lists prices and specifications.

RECORDING CAMERA 213
Fairchild Camera & Instrument Corp. 8-page illustrated booklet describes the Fairchild System Siemens—Recording Cameras. Gives specifications, features, advantages and uses.

EQUIPMENT

TRANSPARENCY ILLUMINATOR 214
Moviette, Inc, 4-page pamphlet describes the Vuette Color Transparency Illuminator. Gives complete specifications.

PRINT PROCESSOR 215
Bernalen, Inc. Specification sheet for the 16 x 20 professional line Ektacolor "type C" print processor. Contains a separate price list—bulletin #A1—of recommended accessories for this processor.

POLECAT 217
The Brewster Corp. 8-page illustrated folder describing – Polecat – a strong, featherweight, telescoping aluminum column support for photographic lights, backgrounds and reflectors. List prices.

ROLOR CATALOG 218
Rolor Industrial Corp. 26-page illustrated catalog of photographic processing equipment. Indexes topics. Lists labs using the equipment described.

UNIVERSAL PRINTER 219
Siok Universal Photo Printer, Inc. 6-page illustrated brochure tells of the Siok Printer Control System. Features the contact printer with control of dodging-contrast speed, used for variable contrast papers and all conventional papers. Brochure illustrates operation.

INTEGRATED SYSTEMS 220
T & S Brass and Bronze Works. Bulletin No. 501L describes with illustrations the lab-flo integrated laboratory water flow systems.

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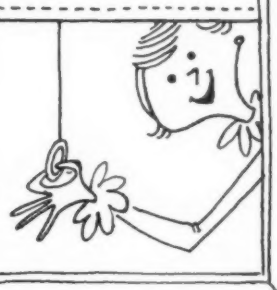

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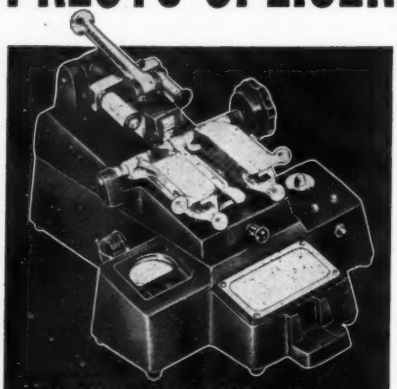

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Get more information. Circle 482, page 91

COLOR ANALYZER 216
Midwest Aerial Photographic Survey, Inc. 6-page illustrated folder describes the Speedmaster Color Analyzer for commercial photographers, photo finishing laboratories, and commercial color labs. Gives specifications.

CUTTER AND TRIMMER 221
Michael Lith Sales Corp. Illustrated sheet describes the Kutrimmer line of paper cutters and trimmer combination. Gives prices and chart of specifications.

PROCESSING UNIT 222
Charles A. Hulcher Co., Inc. Illustrated 2-sided description and specification sheet for the Gilco 70mm film processing unit. Lists such topics as: twin motor drive, construction, electric or hand operation.

PHOTO ACCESSORY BAR 223
Walter Voss, Inc. Specification sheet for the Voss Photo Accessory Bar—a method to stock and sell small photographic accessories. Gives prices of many different types of photographic accessories plus an illustrated chart of replacement units for the accessory bar.

CONTOUR PROJECTOR 224
Officine Galileo di Milano. 6-page illustrated folder for the Galileo contour projector, including an illustrated analysis of its parts and photographs of all its accessories.

PHOTOGRAPHIC SPECIALTIES 225
J. G. Saltzman, Inc. 8-page illustrated catalog folder of CPS photographic specialties—enlargers, reflecting projectors, animation equipment, optical printers, portable and studio equipment.

INDUSTRIAL INSTRUMENTS 226
Electronic Applications, Inc. 6-page illustrated catalog of EMT industrial instruments. Includes capacitor winding limit bridge EMT 501, capacitor tolerance measuring instrument EMT 508, production capacitor bridge EMT 540, precision bridge for measuring electrolytic capacitors EMT 543, and many other industrial instruments.

MONITORING SYSTEM 227
OPTOmechanisms, Inc. Illustrated sheet describes the photometric monitoring system—a highly sensitive instrument for the measurement of reflected light from a missile or satellite to derive angular velocities and photometric measurements. Lists features and adaptable variations.

INTERVALOMETER 228
National Cine Equipment, Inc. 2-page description and specification sheet on the Intervalometer (time lapse). Lists many uses of this unit and gives prices for necessary adapters.

CONTACT PRINTER 229
American Photographic Appliance Corp. Illustrated description for the APAC 11-CP-automatic roll paper contact printer. Lists many advantages of this item. Gives specifications.

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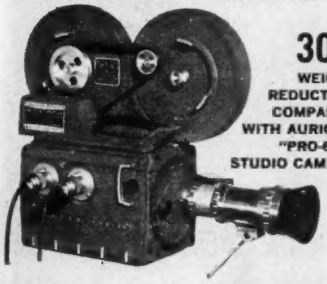

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DURST LABORATOR 230
Durst (USA), Inc. Technical report and 6-sided illustrated folder describing the Durst Laboratory 54—similar to the Durst Laborator 54 autofocus enlarger. Folder includes technical specifications and illustrations of its operation.

PRICE LIST 232
Allen Products. Price list of the Allen line of equipment used for film processing.

COLOR ENLARGER 233
Simmon Bros., Inc. Technical catalog sheet of the Chromega Color Enlarger Model B-10, for 2¼ x 2¼ and smaller negatives. Gives advantages, specifications, contains a magnification chart and ordering information.

PRODUCT-TROL 234
Wessell Organization, Inc. 23-page booklet describing Product-trol—a management device claimed to picture on a day-to-day basis what each business situation is compared to what it should be. Booklet gives detailed advantages, analysis, and uses of this product.

RADAR IMAGE 235
OPTOmechanisms, Inc. Description sheet for the Model 131B—radar image recording system 70mm.

GRAPHIC ARTS

GEVAERT BOOKLET 236
The Gevaert Co. of America, Inc. 12-page booklet titled "Build Your Business With Gevacopy", describes Gevaert's rapid copying system.

REPRODUCTION PROCESSES
Eastman Kodak Co. "The Kodak Compass," a newsletter, on the "how-to" phase of industrial reproduction, brings up the latest information on drawing techniques, reproduction processes and materials. Write to: Sales Service Division, Eastman Kodak Company, Rochester 4, New York.

LIGHT TABLES 237
nuArc Company, Inc. Description sheet for nuArc light tables used for stripping and opaquing. Illustrates Models LT-18, LT-23, LT-42, LT-51 and LT-61. Gives prices.

GRAPHIC ARTS EQUIPMENT 238
Kreonite, Inc. Description sheet for graphic arts processing sinks. Gives complete specifications.

TRIUMPH PAPER CUTTER 239
Michael Lith Sales Corp. Illustrated specification sheet for the Triumph-Jr. office paper cutter. Gives specifications and other models. Lists prices.

UNUSUAL EFFECTS 240
Mask-O-Neg. 4-page illustrated leaflet shows some unusual photographic effects obtained with Mask-O-Neg. Also gives some helpful hints on preparing copy for reproduction.

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MOTION PICTURES

PROGRESSIVE ANIMATION 244
Pictronics Corp. Specification sheet on the Super Speed Dunning Animatic Strip Projector, which provides such motion picture effects as apparent animation fade-zoom effects, dissolve.

FILM STRINGING 264
American Magnetic Film Striping Corp. 3-hole punched data and specification sheet describing Lamnatrack—a new laminated magnetic soundtrack for film striping. It is claimed, that Lamnatrack will not dissolve in splicing cement and has excellent frequency response.

SILENT PROJECTOR 245
Victor Animatograph Corp. Description folder for the Kalart 16mm Silent Projector—Model 70-0. Gives operating instructions and shows threading diagram.

CAMERAS AND PROJECTORS 246
Sekonic, Inc. 6-page illustrated brochure describing the Sekonic line of 8mm movie cameras and projectors. Features the Sekonic Electric Eye Movie Camera and the Zoom Projector.

ANIMATION PRICES 247
S.O.S. Photo-Cine Optics, Inc. 2-sided price list for TEL-Anima animation stand, accessories and supplies. Gives brief descriptions of each product mentioned.

CINE QUEEN KEY LIGHT

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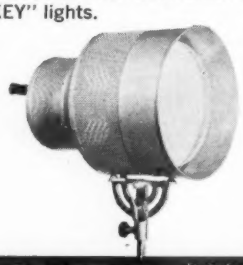

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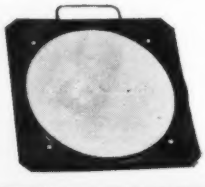

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SERVICES

DUPLICATING CHART 248
Movielab Film Labs., Inc. 4-page color duplicating method chart, for duplicating from color negatives or color positives. Gives a description of color camera films used in Movielab's color methods.

INSTRUCTION MANUAL 249
National Camera Repair School. Wall chart describing tests made on the Servi-Shops Motion Analyzer. Presents the ABC method of using the analyzer in easy reference form.

TV PRODUCTION SERVICE 250
Triangle Productions, Ltd. 4-page illustrated brochure tells of the TV production services available. Describes the multi-stage studios, mobile videotape studio and extra services.

COLOR PROCESSING 251
Cascolor Laboratories. Price list of Ektacolor processing and printing services. Gives Ektacolor-Kodacolor Exposure References.

PHOTOGRAPHIC SERVICES 252
Benson-Lehner Corp. 4-page brochure setting forth the photographic services now available from the Field Engineering Division of Benson-Lehner Corp.

COLOR PRINT TECHNIQUE 253
Richard Coletti Associates. 3-page description sheet, plus photos, telling of the new color printing technique of Colorlitho, a division of Richard Coletti. This service is available to in-plant photographers, professional photographers and advertising agencies. Lists general prices.

SUPPLIES

POWER MITE 257
Florman & Babb, Inc. Description sheet for Power Mite Nickel Cadmium Batteries. Gives prices of models available. Discusses such topics as: operation, supply, charging, and maintenance.

JOBBER PRICE LIST 258
Enbee Transparent Specialty Co., Inc. Jobber price list includes clear sleeves, combination (matte one side) sleeves, and tubes for black-and-white and color roll film.

PHOTOGRAPHIC PAPER 259
Air Photo Supply Corp. Specification and description of Luminos Photographic Paper. Gives specifications in chart form. Includes order form for interested customers.

AVLITE 261
Macbeth Daylighting Corp. Price list of "Avlite Products"—transparency and print viewers. Also includes Avlite replacement tubes and accessories.

PROJECTION LAMP 263
Sylvania Lighting Products. Description bulletin for the two new 8mm super Tru-Flectors—projection lamps.

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NEW PRODUCTS

Professional Photographers of America and National Audio-Visual Association trade shows reap an early summer harvest of products for the industrial man, with a new pro 16mm reflex the pick of the crop

We told you you should have come to the 9th annual National Industrial Photographic Conference of the Professional Photographers of America—and we were right. Rivaling the center ring, the excellent professional sessions, was a trade show of the first water.

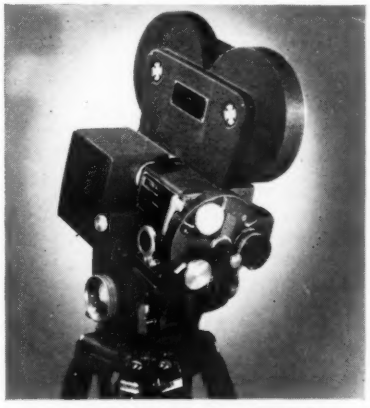
Nothing like a camera

The **Kodak Reflex Special Camera, 16mm,** is a 25 lb. new-born which does not bounce, we were told, because of a "space gate" of novel design that does away with registration pins and yet keeps frame after frame in precisely the the same position. If we knew how it worked we'd probably be writing patent applications, but when we pressed him on the issue, one man standing in a yellow box challenged us to compare frame steadiness on this camera with any on the market, regardless of price. The space gate, he added with calm assurance, provides a seven thousandths clearance between pressure pad and aperture plate, which does the following: virtually eliminates the possibility of binding or scratching as the film passes through the feed mechanism, helps out with the thicker color emulsions, and reduces the tendency toward emulsion build-up at the camera gate.

Just as important, but probably less novel, is the reflex finder. It operates off a mirrored variable shutter which bounces the image onto a ground glass screen. You focus on the screen with 20X magnification that can be dropped back to 10X for viewing. There is a blackout business in the finder that can be flipped into place to eliminate stray light when using an accessory director finder.

The third spear of the trident is the future possibility of synchronous recording with pre-striped film. Kodak literature in the past has criticized this method of sound recording, largely because of the danger of damage to the solutions and to the stripe in processing; and it stretches our imagination to think of a pre-stripe with such films with a backing removed in processing (they call it Rem Jet backing)—as Eastman Color Negative and Kodachrome except on the emulsion side. But we'll see how these clever fellows work it out. The recording head is to be available soon as an accessory; it will fit inside the camera in a space ordinarily occupied by the 100-ft. roll chamber.

Standard drive is a 24 frame per second synchronous motor. A three-position turret with special bayonet mounts (adapters will be available for the Cine Special S mount lenses) is equipped with a 25mm f/1.4 Ekton lens made to order by Angenieux. The camera is shipped with a 400 ft. magazine. Options are a 1200 ft. magazine, lenses from 10 to 150mm and a 17.5 to 75mm zoom, variable speed



Kodak 16mm Reflex Special

motor, director finder. Base price is 1895 American. Watch that back cover for more details.

In the still field, there were two cameras yet a-borning. A man from Minneapolis had a drawing of a 70mm **Camerz** hand job, while **Beattie-Coleman** was passing around a prototype. Both are due for some revision, but the Beattie-Coleman unit is nearer final form. It presents some interesting ideas: The format takes full advantage of the 70mm width (no sprocket holes) and enlarges to 4 x 5 or 8 x 10. A magazine back detaches from the camera, takes bulk film. The ends of the camera bulge out to a handy pair of grips, a winged ring around the lens moves one way to cock the shutter and the other to trip it. Unit, click-stop lever focusing. You can operate the camera wearing choppers' mittens. B-C is thinking hard about a rangefinder. They're asking for a vote. Circle the number, and they'll send you a questionnaire. Gestation period is undetermined.

Decidedly new developers

Every time we write about developers, there's a guy out there who rips off a stinging letter asking if we don't know about pyro, and how can we be so stupid. Well, let us mention pyro even if it was not at the show. There were some developers there, however, and we'd be amiss if we neglected them. To quote the man from Ansco, **Hyfinol** develops film to rated speed in 6 to 8 minutes and will develop over 100 8 x 10 sheets or 120 rolls per gallon without replenishment and without any increase in development time. Quality-wise, chief advantage claimed is high acutance. Furthermore you get latitude, fine grain, maximum shadow detail, forced development without fog or filled-in highlights, etc., etc. Kodak's contribution is **Polydol:** "It assures the same high-quality results for the 1,000th film as may be obtained for the first film in the solution." Replenisher is added to keep the solution up to level.

It's been a long time since we were forced to turn in our glassware breakage card for ogling the chem lab proctor (she was a lady), but offhand it seems to us that there are two things that slow up a film developer through wear and tear. One of them is oxidation of the developing agent as it reduces silver ions, or air or anything else for that matter. This exhausts the developing agents rendering them less effectual, and tired. The other problem is the production of development by-products which in some cases speed up development, but which most of the time slow things down. The worst offender is probably the bromine ion. Potassium bromide, indeed, is a standard restrainer for developers, so you can see what happens when it builds up from the silver bromide crystals latent images are made with.

One class of developer, namely those utilizing Phenidone, is unaffected by bromine concentration

(continued on following page)

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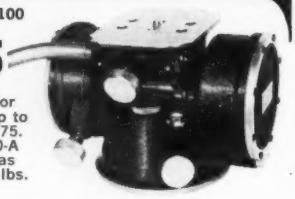

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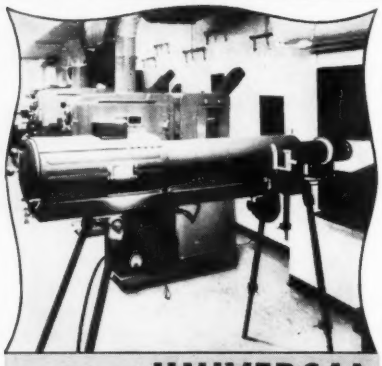

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if we heard right while Dr. Kendall was explaining this unusual developing agent to us. Dr. K. developed Phenidone for Ilford while the British were simultaneously plagued by a metol shortage and the Nazis.

Now, Phenidone would explain how to skirt the by-product problem. How about the exhaustion? We can only speculate, the formulae are not published. It is possible that a reserve of developing agent is kept, so to speak, out of action until their fellows in active combat are picked off by the enemy (the silver halide in the film) then they rush in to save the flag. This is not as silly as it sounds. Buffering is an old story in solution chemistry as we found out from the aspirin ads.

In any case, it appears that the professional photographer now has his picks of two stabilized, self-replenishing developers suitable to his working methods and quality standards. It is a signal advance to our way of thinking. We want to see the variables in the esthetics and not the mechanics of photography.

Incidentally, Dr. Lowe of Edwal demonstrated TST, a liquid concentrate for paper processing. You dilute it 1:12, 1:16 or 1:19. In sum, Dr. Lowe says TST is good, convenient, and cheap. An improved Cormac Unibath comes in powdered form.

It's a fraud but it's fast

The people at the Ilford booth were showing what a little skulduggery could do for the alert ladies and gentlemen who, by maintaining a constant vigil on radar, keep the planes from crashing and falling out of the sky—most of the time. We've reported on the **Kelvin & Hughes** rapid processor previously, but for you skimmers, it's a big machine that exposes a frame of 35mm film to a radarscope, clamps the film, squirts hot processing solution at it, and seconds later projects the image on a large screen, while the next picture is being readied. The new business is a color system which permits the radar data to be segregated by colored filters during exposure, then delivered up as a colored image in 20 seconds. The color is fake. That is, blue comes out green, green comes out red, blue and green (or white) comes out white and red or no light comes out violet. Don't try to figure it out; doesn't matter. The point is to segregate the data; the color is purely symbolic. The processing cycle is developed in a B&W developer, ID-57, fix in IF-18A whilst spraying another chemical on the film, wash and dry. At present, you need a Kelvin & Hughes unit to accomplish this. **Ilford BiPack Recording Film** is the name of the stuff.

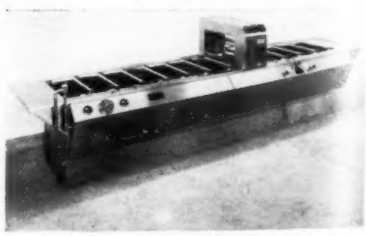
Color, color, color

There was plenty of conventional-type color news at the show, too. Kodak announced a new internegative sheet material which is covered at length elsewhere in this issue. Coming soon will be a new Professional Ektacolor print paper. Big change is in the yellow dye, which is a lot less orange but as Falstaff knew, there's a little yellow in everything, so greens and creams do better too. An October release date is planned. The paper works only with the 75F processing temperatures pros and custom labs use, can't be souped up with elevated temperature processing for photofinishing. A Stabilizing Additive to the buffer solution for this **Kodak Ektacolor Professional Paper** "improves dye stability." Four new color compensating filters, Kodak CCO25C, CCO25M, CCO25Y and CCO25R are now available for eensy, weensy correction.

The Ansco Division of the General Aniline & Film Corporation, Binghamton, New York, announced **Anscochrome 6500:** balanced for speedlight with a nominal speed of 100, "in grain, sharpness, D-max and other characteristics, this new color sheet film is comparable to regular Anscochrome" with a speed of 32.

The **FR Corporation** demonstrated its previously announced color negative printing paper. Available in England for some time, the material is now being manufactured in the United States. It offers a simplified, short processing cycle. **Agfa** re-introduces CN14 in 35mm for professionals only.

The Rolor people were there with an automatic self-contained processing unit for batch work that requires only that the operator load



Rolormatic Processor

the film on one end and unload it on the other. It's not for the one-man photo department, but it does bring the advantages of automation to the big unit active in color and the custom processor. An overhead programmed carriage mechanism does the work. It's called the **Rolormatic Processor.**

Beseler went the other way with a "modular" **Moducolab** processor which is designed to be rearranged as the demand for color work increases, starting with the bare essentials, if shimmering stainless can be described as bare. The Beseler table top dryer has been redesigned for color print work. The drum is now tri-metal for better heat distribution.

Rapidity

Speaking of processors, PPofA men had a chance to learn about some interesting developments in black-and-white film processors: Kodak's **Viscomat** and **Roller Transport** units. The former applies a thin layer of viscous solution to micro and movie film, producing conventional results in an unconventionally short processing cycle. The latter, shown as a preview, engineering model, is an outgrowth of a highly successful radiographic film processor. It is now designed for sheet film, and 4 x 5 to 11 x 14 material dry to dry in about six to ten minutes, with no fudging on thoroughness of wash. An accessory for roll paper is planned, and people using the X-ray predecessor have been known to slip a roll of 120 in the maw and in minutes get negatives out of the other side. A fancy system of rollers gently guides the film through the solutions, which are automatically replenished, filtered and recirculated.

Sensitized goods

VeeCee, Ansco's variable contrast paper that can be used with competitor's filters is joined by a **VeeCee Rapid,** with a higher speed. Less contrast with low number filters, and more contrast with higher number filters are claimed. Kodak **Improved Gravure Copy Film** with its sweet little peaked shoulder is about 10 times as fast as the previous version. Furthermore, the new stuff prints on No. 2 paper instead of No. 1. **Plus-X** is now available in a sheet film said to beat the pants off **Panatomic-X** sheet film for speed and match it for image qualities. Kodak R-S (for red sensitivity) Pan Sheet Film is a new, fast film with increased sensitivity in the red third of the spectrum (they could call it double Tri-X but then they'd be at sixes and sevens). Most Kodak sheet films will get a matte surface front and for easier retouching Kodak **Plus-X Pan Film (Estar Base)** and Kodak **Royal Pan Film (Estar Base)** with also come with the matte finish in 3½ in. x 75 ft. rolls. The Estar base helps with drying. All the 3½ in. and 70mm roll products from Kodak are now being edge numbered with a factory exposure. The numbers are 0000 through 9999, and fortunately they are constructive. Ilford offers **FP3 Type II** in a sheet film.

Hard goods

Hico, the Massachusetts electronic flash man, showed the prototype of an electronic flash meter as yet unnamed which will sell for less than a C note even in a version equipped with a ground glass probe. Ilford has revised their **Multigrade** filters, offers them in glass with metal mounts. The **Durst S-45** Special condenser floor model enlarger for 4 x 5 negatives is loaded with features and flexibility. The Durst **V-184** is an improved version of the 8 x 10 Laborator. **Carlwen Industries** has a bewildering number of patented glassless negative carriers that hold a whole strip of negatives; new this year is a series for electron microscope plates; a *rara avis,* all right, but Carlwen can supply them for almost any enlarger. Kodak has an improvement for their roll printer but the name is so long we can't fit it in these tight columns; there's also a photoelectric pickup for the automatic roll cutter; you can now

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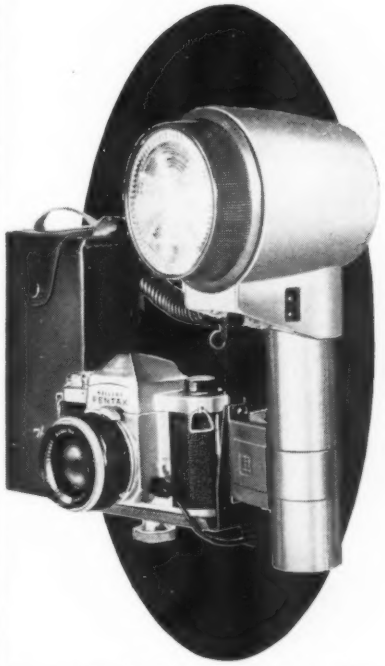

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Durst Laborator V-184

print the mark photographically instead of with a pencil. The Quick-Set **Travelin' Sam** fits in a compact fiber case, but is a tripod of the studio class. With an extension device it puts the camera anywhere from about eight to 80 inches from the ground.

Graflex showed a 270mm lens with the efficient Graflex 1000 shutter. There's a new time-lapse motor for the **Arriflex.** LogEtronics has an automatic; electronic focusing device, the **Focotron,** at $400. Pako has a new rotary washer, the **Pakolux M2,** with a fiberglass tank, a **Midgit** washer that handles 15 8 x 10's in a jiffy, and a new **Color Prosser** that takes two strands of 8 x 10 roll prints. Sylvania showed a **Professional Sun Gun,** a more powerful version of the high-intensity, high-efficiency, steady-output light source. Photo Electronics showed its quartz line **Johnson Beam** and an 800-ws 8-pound battery and ac powerpack. Kodak's **Pageant Showtime** 16mm projector now has a solid state (transistorized and diodized) sound system with a new exciter lamp system that doesn't poop out.

Meanwhile, back in Chicago . . . Our spies at the NAVA (National Audio-Visual Association) convention in July report more than a few

More PPofA Products

Circle the numbers on page 91 for more information.

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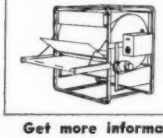

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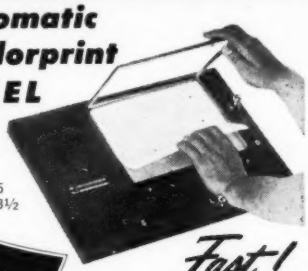

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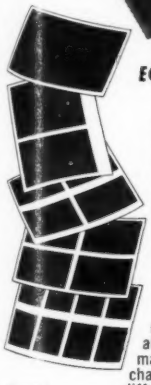

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goodies for industrial men amongst the language labs and teaching machines at the Cook County conclave.

Biggest news is a Graflex 16mm sound projector. Through its parent company, General Precision Equipment Corporation, Graflex has for some time been rubbing shoulders with audio-visual and theatrical equipment suppliers, but the **Graflex Galaxy Super Fifteen** marks the entry in a new field of the famous camera manufacturer's name. Some of the attractive features of this new baby, besides its powder blue and charcoal grey color scheme, are conveniently arranged controls, two level illumination offering at the touch of a button "brilliance equal to either 800 or 1200 watts," self-looping drop-in-slot threading, separate base and treble control, phototransistor sound pick-up, 15W amplifier, two speakers. There are so many other niceties, Graflex advises you to try the machine itself.

Not to be outdone, the Bell & Howell people were stationed a few potted palms away with the **Model 535 Filmosound**; the advice

B&H Model 535 Filmosound

here is to lift the projector. Through the use of fiberglass (for the case), magnesium from the sea, miniaturization from the missile factories, black coffee and butterless sandwiches, B&H engineers have managed to strip 8½ lbs. from the weight of previous Filmosounds, while making the 16mm projector even prettier. Bell & Howell, of course, has been at this game a long time, but they are always up to new tricks. The 535, we are told, was tested with the aid of the U.S. Weather Bureau. "Films of all ages and of varying qualities were run through the Filmosound at more than 100 meetings in nine states recommended

(continued on following page)

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La Belle Teleguide 137
Graflex Audio Graphic System 138
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S & S Selectroslide 149

for their wide range of climatic conditions." We don't want to be picayune, but that sounds like a waste of Chicago's natural resources. The projector is in the $600 range.

Another debut in the projector business at the show was the **Lytlevision,** 8mm motion picture magnetic sound projector. It comes in two versions. With the 200 you get record and playback, microphone is included. The 200A offers, at presumably less cost, playback only. Both accept continuous magazines. Both have a projection screen in the cover.

If you've been reading PMI carefully, you know about the immense practicability of a workbench-top automatic slide projector and audio playback in teaching assembly workers how to put things together. Individualized sound-and-sight how-to-do it instruction in specific cases cuts learning time in half, leaves no bases untouched and imparts good old American know-how like nobody's business. La Belle and the aforementioned Graflex people package this idea nicely with the **Teleguide** and the **Audio Graphic System** respectively. They used 35mm 2 x 2 slides and a foot-pedal-operated magnetic tape playback, earphones, automatic slide changing. Another bid for this market is the Gray Manufacturing Company's Industrial D-Scope **Audioslide.** Basis of this unit is the Audioslide—a square flat business with concentric phonograph-type grooves that will take up to ten minutes of sound. In the middle is a 35mm mounted or unmounted transparency to go with the sound. We advise circling the numbers on the card for the sales literature on these units; the flyers provide an education in themselves for a wide-awake industrial man.

Graflex Audio Graphic

Other advances on the A-V front that you would have known about had you been at NAVA include the following: A **Califone Comet** tape recorder with claimed flat frequency response within plus or minus two decibels from 50 to 15,000 cycles per sec. at about $300; and a **Califone Listening Station** (no record, only play back) with eight headphones. A $32.50, 4 lb., silent **Poly-Vue** filmstrip projector by Richard Manufacturing Co. A raft of time-study motion picture drives and a 16mm motion analysis projector from **Lafayette Instrument Co.** A lighter, brighter overhead projector, The **Projecto-Lite** from Ozalid. Specialized closed circuit video equipment from **Closed-Circuit Corporation of America** including a unit that scans data without a camera. Don't ask us how it works. Ditto for **Eugene Singer Electronics Company** closed-circuit TV division. Radio Corporation of America's **'Lectronic Lectern**—a portable device—incorporates mike, speaker and a place to put the notes. A new color coding system for **Irish Tape** (green and orange?) to put your tape library in shape. Last, but not least, is what the Spindler & Sauppe people characterize as a new dimension for the already unique **Selectroslide:** random access selectivity. A little control panel permits the operator to press a button or two and have the Selectroslide pop into place any one of 48 2 x 2 slides quick-like. You thought there were only four dimensions; hal!—THE END

WANT MORE INFO?

For more information on the new products mentioned in the show reports, circle the appropriate numbers on the reader's service card, page 91.

MICROREPRODUCTION

(continued from page 35)

minute are fed into a sorting magazine which has a capacity of 500 cards. The filing clerk uses the magazine to file each film card by number into the appropriate "capsule" which is a small metal spring-loaded container which has a capacity of 200 film cards. Just as the card is the single unit of information, the capsule is the basic unit of storage. It can be filled with cards to its capacity or used partially filled as the needs of the application may dictate.

The filing operation is governed by the numerical code incorporated in the film card in visual form. Considerable care is taken to insure that the film card reaches the proper capsule, but within the capsule the cards are filed in random order. Filing speed is approximately 10 cards per minute.

The MEDIA storage cabinet contains ten numbered drawers each of which has 100 "nests" for individual capsules. The cabinet can contain up to 400,000 pages of material and the space compression is enormous as compared to standard file cabinets. Moreover, the numbering system allows searches to be narrowed down to a single capsule, or within a maximum of 199 numbers of a single card.

High-gear operation

Assume that the film has been processed, properly encapsulated and stored in a cabinet in accordance with the numerical code. A search is needed. The request is made on the basis of a document number. The cabinet and drawer numbers quickly narrow the search down to a single capsule. This is removed and placed in a major piece of equipment, the Selector-Reproducer. Essentially this machine incorporates apparatus for high speed searching and for making enlarged paper prints. The code number is keyed into the machine and searching proceeds at a constant rate of 15 cards per sec. When a match is found, the card feed stops momentarily while an exposure for an enlarged print is made, then continues until the capsule is run through, when it is refilled and refiled. As the capsule returns to the file the enlarged hard copy is used to fill the search request.

Machine searching with associated production of hard copies could be too fast and too expensive for some applications. Accordingly another kind of consultation equipment termed a "browser" has been provided. (The table and floor models of this machine are known respectively as the high and low browsers.) It is a reading machine fitted with a hand feed for film card capsules. The user cranks cards manually through the machine and inspects the enlarged images on a reading screen. The additional refinement of a reader-printer has been built in, and the user need only press a button to make an enlarged copy of the document appearing on the screen.

The "browser" type of consulting mechanism has some important advantages, for it can serve as the selector-reproducer for small files or for large files of low activity characteristics, thereby materially decreasing the cost of the operation. It can supplement the high speed Selector-Reproducer. More importantly it can be used for the consultation of material that has been filmcarded on a basis other than that provided by the numerical code. For some uses a subject arrangement may be indicated. While not as easy as numerical arrangement, subject organization is possible, but the precise location of the document may not be known. The "browser" allows the user to scan a number of subject cards in a relatively narrow area to obtain the right one without requiring an excessive number of positive enlargements as would be the case with the selector-reproducer.

Quick search

The MEDIA system offers appreciable space savings in setting up and maintaining an organized documentation file and includes the mechanized retrieval of desired information. It is claimed that within a file of 30,000,000 pages, a hard copy of any desired page can be produced in less than a minute. Security duplicates are readily available in this as in any microfilm system. The unitized card makes infiling or discarding easy. In fact if suitable provision is incorporated in advance in the coding system, the file can be made to purge itself of obsolete or unwanted records during the searching operation. The use of capsules keeps the file intact as nothing is removed in searching. Finally the equipment bill is not great, for the basic equipment includes camera, film cutter, capsules and cabinet, selector-reproducer and browser. MEDIA is an

(continued on page 104)

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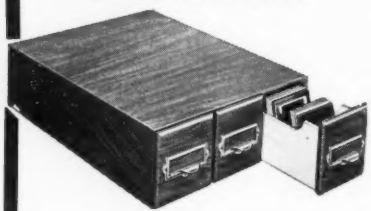
Get more information. Circle 441, page 91

NEGA-FILE

for 3¼" x 4" lantern slides



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Get more information. Circle 467, page 91

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This partial table of contents will give you a preview of what you get in **MOTION PICTURE PRODUCTION FOR INDUSTRY.**

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IN-PLANT TEST

Specifications: Gossen Lunasix Electronic exposure meter. Measures reflected and incident light (with built-in hemispheric diffuser). Has motion picture settings. Thirty degree reflected light acceptance angle. Two-button brightness range system. Automatic needle lock. Built-in battery tester. External zero adjustment. One hand operation (with needle lock). Computer range: ASA 6/1° to 12,000/12°; f/1 to f/90; 1/4000 sec to 8 hr.; cine 8 to 128 fps; EV-9 to EV-22; .014 to 14,000 foot-candles; 7 oz. Price, including case and strap: $63.

Leonard Nadel, Los Angeles magazine and industrial freelance reports: The Lunasix is a highly sensitive meter manufactured in West Germany by Gossen. Meter weighs only 7 ozs. and fits the palm of a big hand comfortably. Frame of the meter is made of plastic, thereby reducing the overall weight. It fits easily into pants and jacket pockets, although a light leather case would afford better protection.

The Lunasix operates on a comparatively new principle of the photoresistor element made of extremely sensitive cadmium sulfide. The current itself is generated by a miniature mercury battery and has a life of approixmately two years. Battery effectiveness can be checked at any time by merely pushing a tension slide on the back plate of the meter and seeing that the needle registers on the control point.

Of enormous help to the photographer I found is the memory feature: the meter needle freezes on the scale upon release of the push-button. The Lunasix will register as low as .014 ft. candles, an extremely low value. At the other end of the range of its sensitivity it will register as high as 14,000 ft. candles. I was amazed that I could get readings in low light levels with the Lunasix that previously I could only guess at. This was particularly helpful with color film, where the meter proved its accuracy.

The Lunasix can be used as either an incident or a reflected light meter; a sliding device with a click

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stop converts it readily. Since I prefer the incident type exposure meter, I merely taped the slide to the incident position. I wanted to prevent any possible mistake.

I found that both the incident and reflected light readings coincided. However, when used as a reflected light meter, it has a 30 degree acceptance angle, a good deal smaller than most meters; the narrow angle provides for more accurate measurement.

The Lunasix exposure calibrations range also from 1/4000 sec. all the way up to 8 hours, with all the intermediate settings for the widest range of shutters. The apertures range from f/1 to f/90. The dial for reading both the f-stops and shutter times is smooth and firm and can be operated readily with one hand. A small window makes provision for cine speeds. The ASA exposure indexes go from a low of 6 to a high of 12,000, and there is also a scale for both the EV and the new logarithmic ASA scale.

While the manufacturer is thoughtful to make provision for every calibration system and incorporate them into the face of the meter, I found a tendency for confusion in having so many scales on the face of the meter. It reminded me of the calendar watches that show month, date, meridian time, sweep hands for seconds and split seconds, etc., so that often one cannot see the forest for the trees. To offset this confusion I simply covered those scale windows I did not require with black tape and was thus able to concentrate on the ones I needed quickly.

I found a number of definite improvements and very desirable advantages in the construction and operation of the Lunasix exposure meter: elimination of loose and unattachable slides, simple and ready conversion of the meter to either incident or reflected light use, light weight, a built-in memory through freezing the needle on the scale, its ultrasensitive low value scale that gives me highly reliable reading where previously I could only guess with former meters, a checking device on the battery efficiency, the use of effective color accents to help distinguish various features on the meter, readable scales, a firm construction that can absorb normal buffeting. To improve the minus side, I would recommend the use of a different color to distinguish more quickly the high and low scale. I would also prefer that the EV scale be eliminated or moved, as it is too close to the light indicator scale.

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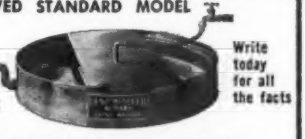

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Get more information. Circle 475, page 91

IND. MOTION PICTURES

(continued from page 36)

shall you smoke?

Kidding aside, there is a lot that the commercial and industrial film maker can learn from the so-called "new wave." One of its valuable characteristics is a heightened realism due to its spontaneous quality. The camera is made a casual observer that does not intrude on the screen; "it just so happened that a camera was there." The unrehearsed accidental action adds to the convincing quality. The spontaneous, sometimes right-on-the-spot sound recording gives an air of naturalness and carries with it an aura of honesty. The "available light" type of lighting helps convince the viewer that he is getting the "honest truth."

Amateurs are irritating

This may sound as though I am advocating amateur techniques that can be employed by those who have never made films. Not true. To achieve this so-called naturalness consciously, one must be a master of his medium, with a great deal of control. Amateurish technique will only irritate the viewer. It must be realized, too, that not all subjects lend themselves to this type of film. A film maker who uses his own creative imagination will always find an appreciative audience.

New Wave technology

During the past few years all kinds of portable equipment have been developed to help the film maker achieve this greater realism. There are small wireless microphones that people may conceal on their person. They can then walk around without having wires to hamper their movements; no frantic boom man will try to follow them; no microphone will cast shadows or get into the picture. There are new synchronous tape recorders with built in batteries that weigh only a few pounds. New methods have been evolved of synchronizing ¼ in. tape, new methods of cueing, to eliminate the cumbersome slapsticks. New wide angle lenses encompass a wider view than does the human eye, and functional portable lights weigh only a few ounces. There are new reflected light systems that give the appearance of available natural light. Also at hand are new methods of dubbing sound, making it possible to do without a sound studio.—THE END

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Get more information. Circle 478, page 91

LETTERS

(continued from page 22)

wood, Long Island, New York.

The Vertoscope is a desk top unit, accepts a 2¼ x 3¼ negative (although larger sizes can be made on special order), shows a same-size image, and takes house current. Price is about $600.

It might be noted that any television system can be used in such a way that positive image of a negative original appears on the screen, by receiving polarity somewhere in the system. Thus, many television stations are able to transmit negative originals to home sets as positive images.

This property of the television system has been utilized in the Hazeltine color analyzer, used for predicting proper color balance for motion picture color negatives. A story of the Hazeltine unit in use at Cape Canaveral is contained in the December 1960 PMI. It is a good deal more expensive than the Vertoscope.

Recently Brian Hooper, North Hollywood, Calif., showed his Nega-Viewer. This is a closed circuit television system on somewhat the same principle as the Hazeltine unit, but designed for black-and-white conversion only. For more details, see page 72.

To the Editor:

While I have this paper in my typewriter, I wish to answer some of your editorials in regard to the activities of amateur photographers in industry.

The mere fact that a man has been hired as a photographer and issued a 4 x 5 Graphic does not always make him a competent photographer. In my work at Grand Central, I have often quarreled with the photographic department; I think with justification. When I can make a sharper, less grainy 8 x 10 print from my 35mm negative (not to mention my Linhof 23) than the photographic department can from a 4 x 5 negative, why should I have to put up with shoddy work to keep a so-called professional photographer happy?

I think that adequate research will show you that, where the photographic department is having trouble with amateur photographers in the organization, you will find that the so-called professionals are giving poor service or shoddy work or, quite frequently, both.

(continued on following page)

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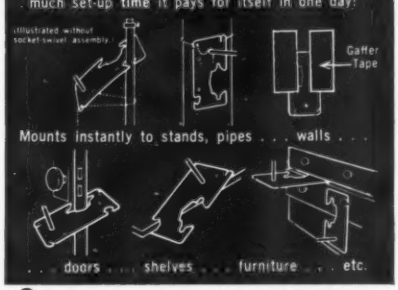
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Get more information. Circle 503, page 91

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Get more information. Circle 493, page 91

WHO *in the world?*

Who in the world makes closed circuit TV systems? Processing water jackets? Negative retouching equipment? Transparency illuminators? Enlarging exposure meters? Light-proofing materials? Slide binding equipment? Presensitized offset plates? Color processing units? The answers are in the new PMI DIRECTORY. Do you have a personal copy? It's free with your subscription to PMI.

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PMI DIRECTORY

Most engineers have enough to do without making the photographic records necessary for adequate reports. They do this only because they have learned from bitter experience that this is the only way of getting good work in a reasonable time. In my own case, I have been asked to make photographs for other workers after the "pro" had botched the job.

E. Leon Foreman, Ph.D.
Redlands, California

To the Editor:
Subject: Editorial in June 1961 issue (page 31)

Your Editorial expresses our feelings exactly.

Robert H. Murray
Arlington, Va.

To the Editor:

Where can I purchase a projector that will accommodate 35mm and 2¼ x 2¼ positives and transparencies?

Capt. H. E. Cottrell, USMC
Marine Corps Schools
Quantico, Virginia

Write to Burleigh Brooks, Inc., Bell & Howell Co., and Bausch & Lomb, Inc., for the addresses of the nearest dealers stocking their 35mm/-2¼ x 2¼ projectors.

MICROREPRODUCTION

(continued from page 99)

interesting system.

Success or failure in any mechanized or automated data storage and retrieval system depends quite as much on precision of reference as it does on speed. Organization of the file and the development of an appropriate coding system that can achieve the required degree of precision with the particular documentation under consideration, and within both the capacities of the equipment and the budget is the problem facing the documentation specialist or the systems engineer.

Insofar as hardware is concerned the newer types of equipment that have been discussed in recent columns offer absorbingly interesting possibilities for using microreproduction in the attack on a whole galaxy of problems. There are other devices in prospect. A number of different concepts are being explored and a good proportion are in advanced development. Some at least should appear in the arena to battle for public acceptance in the relatively near future.—THE END

HYZER ON HIGH SPEED

(continued from page 86)

in brightness that is followed by the burning out of a lamp filament.

Type V, Spontaneous. An event that initiates without warning, external control or guidance (as if governed by the laws of nature, internal impulse or chance). There are two types, natural and incited.

Natural spontaneity is self-initiating, the operator has little or no control over it. An example would be the flight behavior of an insect.

Incited spontaneity may be prompted by the operator, but occurs in an unscheduled manner. An example would be the cracking of brittle material under a static load. The operator sets up the conditions that inevitably result in the material's cracking, but he has no control over, or advance knowledge of when the cracking will occur.

Set in this framework, it is fairly easy to relate the potential of a camera to the requirements of a type of event. I have done this in chart form.

Generally the problems associated with synchronizing the camera and the event become increasingly difficult from left to right across the chart, and toward the upper and lower right hand corners of the chart.

The table accompanying the chart requires a bit of explanation. Under C, I use the word instantaneously in a special sense. I assume a time interval to be instantaneous if it is less than the period between successive exposure in a multiple-exposure camera system, or if it is less than 5 times the exposure duration in a single-exposure device.

It is also worth noting that self-luminous events may make synchronization much easier. No external light source or shutter may be required, save perhaps a "capping" shutter to eclipse the light after the exposure is made.—

THE END

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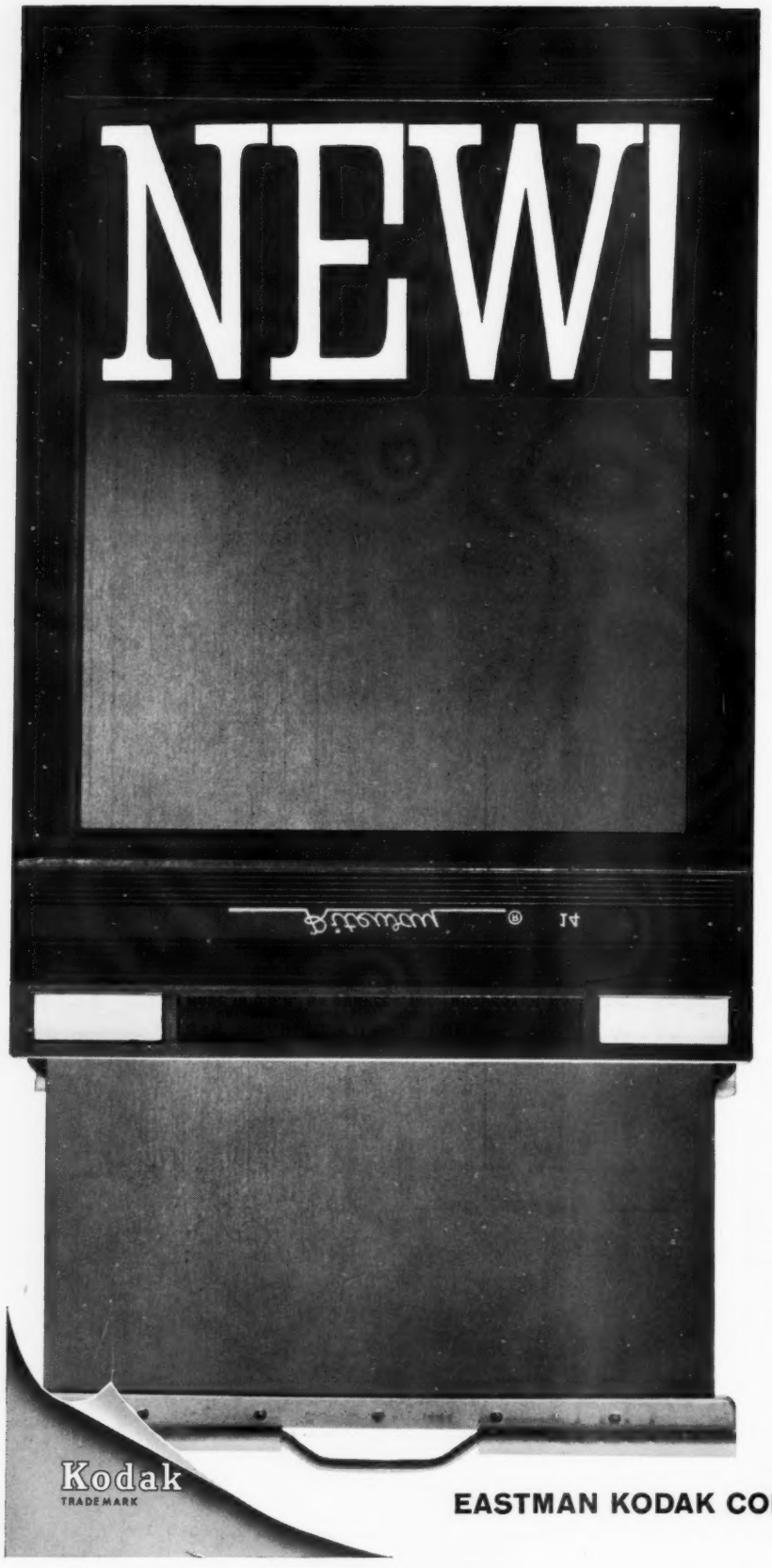

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